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JEB LITTLE CREEK
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EMAIL AND ATTACHED U S NAVY COMMENTS ON THE DRAFT SITE MANAGEMENT PLAN FISCAL YEARS 2015 THROUGH 2019 JEB LITTLE CREEK VIRGINIA BEACH VA
08/13/2014
DEPARTMENT OF THE NAVY

Price, Nathaniel/VBO

From: Stepien, Matthew M CIV NAVFAC MIDLANT, EV <matthew.stepien@navy.mil>
Sent: Wednesday, August 13, 2014 2:56 PM
To: Landin, Cecilia/VBO
Cc: Boylan.Jeffrey@epa.gov; Price, Nathaniel/VBO; Herman, Paul (DEQ)
Subject: RE: JEB Little Creek - FY15 through FY19 SMP for Review
Attachments: Draft Site Management Plan Fiscal Years 2015 through 2019_redline to Team Navy cmnts 13-Aug-14 (includes VDEQ cmnts).docx

Afternoon Cecilia,

Attached are my comments on SMP. I only had three minor comments and piggy-backed off of Paul's copy.

Thanks,

Matthew M. Stepien
Remedial Project Manager
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-----Original Message-----
From: Herman, Paul (DEQ) [mailto:Paul.Herman@deq.virginia.gov]
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Cc: Boylan.Jeffrey@epa.gov; Cecilia.Landin@ch2m.com; Nathaniel.Price@CH2M.com; Peed, Bryan K CIV NAVFAC MIDLANT, EV
Subject: RE: JEB Little Creek - FY15 through FY19 SMP for Review

Matt,

VDEQ comments concerning the Draft Site Management Plan for FY 2015 through FY 2019 are provided in the attached file, a track changes version of the document. VDEQ will not provide a formal comment letter unless one is requested. Please let me know if you have any questions.

Thanks.

Paul E. Herman, P.E.

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Sent: Thursday, July 10, 2014 2:28 PM
To: matthew.stepien@navy.mil; Herman, Paul (DEQ); Boylan.Jeffrey@epa.gov
Cc: Nathaniel.Price@CH2M.com
Subject: JEB Little Creek - FY15 through FY19 SMP for Review

Team,

Attached is the draft FY2015 through FY2019 Site Management Plan for review. The text has been provided as a redline to the previous SMP for a focused review. All figures and tables are provided in pdf. Hardcopies of files will not be distributed unless requested. Please let me know if you have any trouble with the files. The file sizes are large so please shoot me a return email letting me know you have received this email.

Thanks!

Cecilia

Site Management Plan
Fiscal Years ~~2014~~2015 through ~~2018~~2019

Joint Expeditionary Base (JEB) Little Creek—Fort Story
JEB Little Creek
Virginia Beach, Virginia

Contract Task Order WE61

~~**August 2013**~~**July 2014**

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic ~~Division~~

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

CH2MHILL

Virginia Beach, Virginia

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Acronyms and Abbreviations

A-A	~~Anti-Aircraft~~anti-aircraft
ABM	abrasive blast material
AOC	Area of Concern
AST	aboveground storage tank
~~AS/SVE~~	~~air sparging/soil vapor extraction~~
Baker	Baker Environmental, Inc.
~~BERA +3~~	~~Baseline Ecological Risk Assessment through Step 3~~
bgs	below ground surface
CCR	Construction Completion Report
CD	cyclodextrin
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIP	Community Involvement Plan
COPC	~~chemical~~constituent of potential concern
COC	~~chemical~~constituent of concern
CSM	conceptual site model
DCE	dichloroethene
DD	Decision Document
DNAPL	dense non-aqueous phase liquid
DPT	direct-push technology
DoD	Department of Defense
~~DON~~	~~Department of the Navy~~
Ebasco	Ebasco Environmental Consultants
EE/CA	Engineering Evaluation/Cost Analysis
EP	extraction procedure
ER	Environmental Restoration
ERA	Ecological Risk Assessment
ERD	enhanced reductive dechlorination
ESTCP	Environmental Security Technology Certification Program
FFA	Federal Facilities Agreement
FFS	Focused Feasibility Study
FS	Feasibility Study
FWES	Foster Wheeler Environmental Services
FY	fiscal year
GIS	geographic information system
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System
HRSD	Hampton Roads Sanitation District
IAS	Initial Assessment Study
IC	institutional control
IEUBK	Integrated Exposure Uptake Biokinetic
IRACR	Interim Remedial Action Completion Report
IR	Installation Restoration
IRA	Interim Removal Action

IRI	Interim Remedial Investigation
ISCO	*in situ* chemical oxidation
JEB	Joint Expeditionary Base
LCAC	landing craft air cushion
LTM	long-term monitoring
LUC	land use control
µg/L	micrograms per liter
MC	munitions constituent
MCL	maximum contaminant level
~~MDL~~	~~method detection limit~~
MEC	munitions and explosives of concern
~~mg/kg~~	~~milligrams per kilogram~~
MILCON	military construction
MIP	membrane interface probe
MMRP	Military Munitions Response Program
MWR	Morale, Welfare, and Recreation
NA	no action
NAB	Naval Amphibious Base
NACIP	Navy Assessment and Control of Installation Pollutants
NAVFAC	Naval Facilities Engineering Command
~~NCP~~	~~National Contingency Plan~~
Navy	Department of the Navy
NFA	no further action
NPL	National Priorities List
NTCRA	Non-~~time-critical~~Time-Critical Removal Action
O&M	operation and maintenance
ORC	Oxygen Releasing Compound®
OWS	oil-water separator
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCP	pentachlorophenol
ppb	parts per billion
~~ppm~~	~~parts per million~~
PRAP	Proposed Remedial Action Plan
PRG	preliminary remediation goal
PSI	Preliminary Site Inspection/~~Site~~ Investigation
PWC	Public Works Center
RA	Remedial Action
RAB	Restoration Advisory Board
RACR	Remedial Action Completion Report
RAO	remedial action objective
RBC	~~Risk~~risk-based concentration
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation

~~RGH~~	~~Rogers, Golden, and Halpern~~
RI	Remedial Investigation
~~RIP~~	~~remedy in place~~
RME	reasonable maximum exposure
ROD	Record of Decision
RRRS	Relative Risk Ranking System
RVS	Round 1 Verification Step
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SCR	Site Characterization Report
SERA	Screening Ecological Risk Assessment
SI	Site Investigation
SMP	Site Management Plan
SPCC	Spill Prevention, Control, and Countermeasures
SRI	Supplemental Remedial Investigation
SSP	site-screening process
SVOC	~~semi-volatiles~~semivolatile organic compound
SWMU	solid waste management unit
TAL	target analyte list
TCA	trichloroethane
TCE	trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TCRA	Time-Critical Removal Action
TOC	total organic carbon
TOX	total organic halogens
TS	Treatability Study
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UTL	upper tolerance limit
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
XRF	x-ray fluorescence
yd^3	cubic yard

SECTION 1

1Introduction

On October 1, 2009, Hampton Roads' first Joint Base was established. This new installation comprises the former Naval Amphibious Base (NAB) Little Creek and Army post of Fort Story; the new name is Joint Expeditionary Base (JEB) Little Creek-Fort Story. With the forming of this new command, the Navy assumes responsibility for management of both properties and will now merge public meetings regarding the ongoing Environmental Restoration (ER) program. However, separate records will be maintained to ensure the integrity of ongoing efforts at both properties. When required for public notices and distributions, the former bases are identified jointly as Joint Expeditionary Base Little Creek-Fort Story. For ER Program documents, the bases are referred to separately as JEB Little Creek and JEB Fort Story. The Site Management Plan (SMP) for JEB Fort Story shall be presented in a separate document.

This document presents the fiscal years (FYs) ~~2014~~2015 through ~~2018~~2019 SMP for JEB Little Creek, Virginia Beach, Virginia. The SMP meets the requirements of the final Federal Facilities Agreement (FFA) between the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division, Virginia Department of Environmental Quality (VDEQ), and Region III of the United States Environmental Protection Agency (USEPA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to address environmental contamination at applicable JEB Little Creek sites (~~Department of the~~ Navy ~~[DON],~~ 2003). The SMP is being submitted for use by the JEB Little Creek ER Tier I Partnering Team and their respective organizations—NAVFAC, JEB Little Creek, USEPA, and VDEQ. **Figure 1-1** illustrates the location of JEB Little Creek.

The purpose of the SMP is to provide a management tool for NAVFAC, JEB Little Creek, VDEQ, USEPA, and consultants for use in planning, scheduling, and setting priorities for environmental remedial response activities to be conducted at JEB Little Creek. The SMP establishes schedules and conceptual approaches for continued CERCLA activities at JEB Little Creek ER sites. The schedules and work descriptions consist of the following:

- Site descriptions and proposed activities for the current FY
- Conceptual schedules and general work approaches for activities planned for the 5-year period FY ~~2014~~2015 through FY ~~2018~~2019

The prioritization of activities and the proposed schedules were developed by the JEB Little Creek Tier I Partnering Team, represented by NAVFAC, USEPA, and VDEQ, and are based on several factors:

- The Tier I Partnering Team's relative ranking of the sites regarding the potential risks to human health and the environment
- NAVFAC's ~~initial~~ internal funding goal of having remedies in place at all ~~"high–priority"~~JEB Little Creek sites by the end of FY ~~2009~~2015
- Goals set by the Tier I Partnering Team to meet requirements of USEPA, VDEQ, NAVFAC, and the public

The SMP is a working document that is updated annually to maintain an up-to-date documentation and summary of environmental actions at JEB Little Creek. This SMP updates and supersedes the FY ~~2013~~2014 SMP distributed in ~~October 2012~~August 2013.

SECTION 2

2Background and Site Descriptions

JEB Little Creek is primarily an industrial facility located in the northwest corner of Virginia Beach, Virginia. The western boundary of JEB Little Creek borders the City of Norfolk, Virginia (**Figure 1-1**). The area surrounding this 2,215-acre base is low lying and relatively flat with several freshwater lakes (Chubb Lake, Lake Bradford, Little Creek Reservoir/Lake Smith, and Lake Whitehurst) located on or adjacent to the base. JEB Little Creek centers around four saltwater bodies: Little Creek Harbor, Little Creek Cove, Desert Cove, and Little Creek Channel that connects the coves and harbor with the Chesapeake Bay (**Figure 2-1**).

In addition to industrial land use, JEB Little Creek is also used for recreational, commercial, and residential purposes. The southeast corner of the base has been developed for residential use and land development surrounding the base is residential, commercial, and industrial. Little Creek Reservoir/Lake Smith, located to the south of the base, serves as a secondary drinking-water supply for parts of the City of Norfolk.

JEB Little Creek grew out of four bases constructed during World War II: the Amphibious Training Base, the Naval Frontier Base, and Camps Bradford and Shelton. It consisted of three annexes named for the former owners of the property—Shelton to the east, Bradford in the center, and Whitehurst to the west. In July 1945, a Secretary of the Navy letter disestablished the separate bases and established the former NAB Little Creek (now referred to as JEB Little Creek) on August 10, 1945. In 1946, the former NAB Little Creek was designated a permanent base, and the base's mission was the training of landing craft personnel for operational assignments.

During the last 50 years, JEB Little Creek has expanded in both area and complexity of its mission. JEB Little Creek personnel provide logistic facilities and support services to 18 home ported ships and 155 shore-based resident commands. The combination of operational support and training facilities is geared predominantly to meet the amphibious warfare training requirements of the Armed Forces of the United States. Past and present operations at JEB Little Creek include the following: vehicle and boat maintenance, boat painting and sandblasting, construction and repair of buildings and piers, mixing and application of pesticides, electroplating of musical instruments, laundry and dry cleaning, medical and dental treatment, and the generation of steam for heat.

2.1 Environmental History

Comprehensive ~~environmental restoration~~ER activities at JEB Little Creek began in 1984 under the Navy Assessment and Control of Installation Pollutants (NACIP) and Installation Restoration (IR) (later termed ER) Programs. The purpose of the NACIP and ER Programs was to identify, assess, characterize, and clean up or control contamination from past waste management activities at Navy and Marine Corps facilities. Given the nature and extent of its operations, the Navy has been involved with toxic and hazardous materials for several decades. The Department of Defense (DoD), as well as general industry, has realized that previously acceptable methods of disposal are no longer sufficient, and actions are being taken, through these programs, to clean up Navy sites that pose a threat to human health or the environment. Current Navy waste management operations are in compliance with all federal, state, and Navy regulations to ensure safe operation and disposal of hazardous substances.

The NACIP program used a three-phased approach to study and to clean up sites. JEB Little Creek initiated its environmental study investigation and restoration efforts under the NACIP program by conducting an Initial Assessment Study (IAS) in 1984 (RGH, 1984). The NACIP program was changed in 1986 to reflect the requirements of CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA). This revised program is referred to as the ER Program.

On July 28, 1998, the USEPA proposed that the former NAB Little Creek be added to the National Priorities List (NPL). USEPA evaluates industrial sites using the Hazard Ranking System (HRS), and those facilities with HRS scores exceeding 28.5 are proposed for the NPL. The HRS score of 50, assigned by the USEPA to the former NAB Little Creek, was attributed mainly to the surface water component at Site 7 (Amphibious Base Landfill). The proposed

listing was followed by a minimum 60-day review and comment period prior to the inclusion of NAB Little Creek on the NPL. On May 10, 1999, the former NAB Little Creek was placed on the NPL.

The FFA, negotiated between the Navy, USEPA, and VDEQ, was finalized in November 2003. In accordance with the FFA, all past and future work at ER sites and solid waste management units (SWMUs) will be reviewed, and a course of action for future work requirements at each site will be developed. The FFA also includes specific requirements for the preparation and contents of this SMP.

The following sections provide an overview of the CERCLA process and a summary of the studies completed to date, facility-wide and site-specific, at JEB Little Creek. **Table 2-1** lists the status of each of the sites at JEB Little Creek. **Table 2-2** lists each of the studies conducted at those sites identified in the FFA as sites requiring additional investigation.

2.2 CERCLA Process

The objectives of the CERCLA process are to evaluate the nature and extent of contamination at a site, and to identify, develop, and implement appropriate remedial actions (RAs) in order to protect human health and the environment. The major elements of the CERCLA process are identified and described in **Table 2-3**.

The documents prepared for the CERCLA program are maintained in information repositories for review by the public. The index of JEB Little Creek Administrative Records is available at the following location:

https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_env_pp/env_restoration_installations/lant/midlant/jeblcfs

http://go.usa.gov/DyzB

Documents are available to the public in the Administrative Record that can be accessed by contacting the following:

Public Affairs Office
NAVFAC Mid-Atlantic
9742 Maryland Avenue, Building A-81
Norfolk, VA 23511
Phone: (757) 341-1410
Joint Expeditionary Base Little Creek-Fort Story
2600 Tarawa Ct., Suite 100
Virginia Beach, Virginia 23459-3297
Phone: (757) 462 8425

Public participation is an element of the CERCLA process. JEB Little Creek has developed a Community Involvement Plan (CIP) and established a Restoration Advisory Board (RAB) comprised of members of the community, local environmentenvironmental group members, and state and federal officials, who meet annually to keep the community informed of environmental issues at JEB Little Creek.

2.3 Facility-wide Investigations

Various facility-wide studies and investigations, including preliminary studies and detailed site investigations, (SIs), have been completed at JEB Little Creek since 1984 in response to the Navy's ER Program. Preliminary studies conducted to identify and assess sites posing a potential threat to human health or the environment resulting from past or current operations or waste management activities include the following:

- IAS
- Resource Conservation and Recovery Act (RCRA) Round I Verification Step (RVS)
- Phase I Interim RCRA Facility Assessment (RFA)

A total of 133 potentially contaminated sites, areas, or SWMUs at JEB Little Creek were identified for evaluation in the IAS, RVS, RFA, and other JEB Little Creek assessments. **Table 2-1** provides the correlated listing of JEB Little Creek sites, SWMUs, and areas of concern (AOCs).

Some of the ~~site investigations~~SIs included multiple sites specifically identified in the IAS for further evaluation and were not focused on a specific site assessment. These major investigations include the following:

- RVS
- RFA
- Interim Remedial Investigation (IRI)
- Preliminary Site Inspection/Investigation (PSI)
- Remedial Investigation~~/~~ (RI)/Feasibility Study (~~RI/~~FS) and ~~Site Investigation (~~SI~~)~~
- Relative Risk Ranking System (RRRS)
- Background Investigation
- SWMU/IR Summary

The details and results of the investigations identified in this section are summarized below.

2.3.1 Initial Assessment Study

The IAS at JEB Little Creek was completed in December 1984 by Rogers, Golden, and Halpern ~~(RGH).~~ Its purpose was to identify and assess sites that posed a potential threat to human health or the environment because of contamination from prior hazardous waste management activities. The study entailed the collection and evaluation of activity records relating to waste generation, handling, and disposal; characterization of physical conditions at the site such as hydrogeology; and identification of migration pathways and potential receptors. The results of these data evaluation efforts were used to develop recommendations concerning the need for a confirmation study at a given site, the goal of which was to verify the presence of contamination and determine the need for further characterization and/or remediation.

The IAS examined 17 sites at JEB Little Creek (IR Sites 1 through 17). Six sites were recommended for confirmation studies: Sites 7, 9, 10, 11, 12, and 13. Of the remaining 11 sites, mitigation measures were recommended for four of the sites (Sites 4, 5, 15, and 16), and no action (NA) was recommended for six of the sites (Sites 1, 2, 6, 8, 14, and 17). Site 3, the West Annex Fuel Spill, was addressed under a separate action to recover free-floating oil from the water table. Site 17, the Building 1256 Motor Oil Disposal Area, was later added to the PSI by the Navy.

The IAS recommendations to conduct confirmation studies were based largely on the finding that contaminants from disposal areas may migrate toward surface water bodies with little attenuation, owing to a lack of clays and organic material in the subsurface soil, and in a relatively short time because of high hydraulic conductivities in the water table aquifer. The potentially affected surface waters included Little Creek Cove, Lake Bradford, and Lake Smith. Lake Bradford and Lake Smith are used for recreational purposes, and Lake Smith also serves as the secondary municipal water supply for the City of Norfolk. Delineation of an actual threat or risk was not possible because of the lack of site-specific hydrogeologic and groundwater quality data.

The IAS presented a number of detailed recommendations concerning the installation and sampling of monitoring wells; the sampling of surface soil, surface water, and sediment; and the types of laboratory analyses to be completed. The recommendations also addressed well completion depths and water-level monitoring requirements. Many of the recommendations were aimed at resolving the data gaps identified in the IAS. These recommendations became the scope of work for the RVS, detailed in the next section.

2.3.2 Round 1 Verification Step

The RVS at JEB Little Creek was completed in October 1986 by CH2M HILL and was the first step in the confirmation study process (CH2M HILL, 1986). The purpose of the study was to verify the presence or absence of contamination at the six sites recommended in the IAS for a Confirmation Study (Sites 7, 9, 10, 11, 12, and 13). The scope of work of the RVS activities at each site was established by the recommendations presented in the IAS, with notable deviations concerning the number of monitoring wells completed and samples collected.

As part of the work conducted for the RVS, 31 monitoring wells were installed for the collection of groundwater samples and groundwater elevation data to determine groundwater flow directions. Surface water and sediment

samples were collected to investigate potential impacts on nearby surface water bodies. Subsurface soil samples were collected to delineate the vertical extent of contamination in probable source areas.

As stated in the RVS, the results of the Round 1 sampling and analysis activities indicated that little or no contamination was leaving any of the three landfill sites addressed in the RVS (Sites 7, 9, and 10). Contamination was detected in one or more environmental media at Sites 11, 12, and 13. These results indicated that contamination was being released from these three sites, but the magnitude and distribution of this contamination could not be determined on the basis of the RVS findings alone. The results of the sampling and analysis activities were used to develop recommendations for additional investigations at all six sites. These recommendations were generally limited to continued or expanded sampling conducted during the IRI to confirm the RVS results.

2.3.3 RCRA Facility Assessment Report

An RFA was conducted at JEB Little Creek in 1989 (A. T. Kearney, 1989). The RFA identified 147 SWMUs and several AOCs where wastes had been stored and/or where contaminants may have been released to the environment. Twenty-two of these SWMUs and two AOCs are associated with the 17 sites identified in the IAS (for example, SWMUs 123 through 126 are located within the bounds of Site 7).

JEB Little Creek decided not to renew their RCRA Part B permit; therefore, a RCRA Facility Investigation (RFI) was not conducted, and the base dropped out of the RCRA corrective action program. JEB Little Creek decided, however, to investigate 17 of the SWMU sites by including them in the Navy's RRRS sampling program. The 17 SWMUs investigated were chosen because USEPA had identified them as the sites of highest concern.

2.3.4 Interim Remedial Investigation

The IRI was conducted in 1991 by Ebasco Environmental Consultants (Ebasco) to determine whether or not further characterization activities or ~~remedial actions (~~RAs~~)~~ were warranted at Sites 7, 9, 10, 11, 12, or 13 (Ebasco, 1991b). The objectives of this investigation were to conduct a second round of sampling at the six sites sampled during the RVS, and to integrate the historical and newly acquired data, along with site-specific recommendations, for further action into a single document. The data were used to develop a recommended response action, a Human Health Risk Assessment (HHRA), and site-specific recommendations concerning additional characterization.

2.3.5 Preliminary Site Inspection

A PSI was conducted in 1991 by Ebasco to assess the threat to human health and the environment from five sites (Sites 4, 5, 15, 16, and 17). ~~Chemicals~~Constituents of concern (COCs) were detected in the groundwater at Site 5, and further sampling was therefore recommended (Ebasco, 1991a). At Site 16, elevated levels of polychlorinated biphenyls (PCBs) were detected in soil, and additional sampling was recommended to delineate contamination. Remediation was also recommended for Site 16. No further action (NFA) was proposed for Sites 4, 15, and 17.

Commented [P.H1]: I thought EPA prefers chemicals of concern.

2.3.6 Remedial Investigation/Feasibility Study and Site Investigation

Between 1993 and 1994, Foster Wheeler Environmental Services (FWES) conducted an RI/FS at Sites 7, 9, 10, 11, 12, and 13 (FWES, 1994b). The RI/FS included a Phase 1 Baseline HHRA and Ecological Risk Assessment (ERA). In addition, FWES also conducted an SI at Sites 5 and 16 (FWES, 1994c). The investigations included soil, groundwater, sediment, surface water, and soil-gas sampling. Additional groundwater monitoring wells were also installed. The FS recommended long-term groundwater monitoring for Sites 9 and 10, a source removal action and post-removal monitoring for Site 11, and additional evaluations at Sites 7, 12, and 13. The SI recommended semiannual groundwater monitoring at Site 5 and a soil removal action at Site 16.

2.3.7 Relative Risk Ranking System Report

An RRRS and a revised RRRS analysis were completed by Baker Environmental, Inc. (Baker) in 1996 (Baker, 1996). The purpose of the analysis was to gather contaminant, pathway, and receptor information for the 17 SWMUs that were originally identified in the RFA as being potential sites affected by contamination. Data were collected for each of the 17 SWMUs through a field investigation in October 1995. The field investigation was aimed at the

identification of contaminants in surface soil, subsurface soil, and groundwater. The results of the investigation were used to identify the relative risk posed by each SWMU according to the contaminants present, the migration pathway, and the potential receptors for each medium at the SWMU. Both human health and ecological receptors were considered.

Based on the RRRS, three of the SWMUs were identified as posing a high risk and six SWMUs were identified as presenting a medium risk. The high- and medium-risk SWMUs are listed below. The SWMUs were consolidated and renumbered as indicated.

- High-risk SWMUs:
  - **SWMU 84—**Demolition Debris Landfill (also referred to as IR Site 8)
  - **SWMU 105—**Steam Plant Flyash Silo ("new" SWMU 2)
  - **SWMU 111—**Pier 10 Sandblast Yard ("new" SWMU 3)
- Medium-risk SWMUs:
  - **SWMU 17—**Small Transformer Storage Area (redesignated as "new" SWMU 1 and also referred to as IR Site 14)
  - **SWMU 117—**Special Boat Squadron 2 Battery Storage Area (redesignated as "new" SWMU 4 and also referred to as IR Site 4)
  - **SWMU 130—**Building 3896 Boat Painting Area (redesignated as "new" SWMU 5)
  - **SWMU 131-133—**Seabee Area (consolidated and redesignated as "new" SWMU 6)

2.3.8 Background Investigations

A Background Groundwater Quality Study was conducted during three rounds of groundwater sampling completed at JEB Little Creek on November 31, 1991, September 15, 1992, and June 30, 1993 (Allied ~~Environmental~~, 1992; FWES, 1994b). The purposes of this study were to collect, organize, and present data on background groundwater quality and conditions.

The groundwater quality information was obtained from a network of eight monitoring wells installed in locations throughout the base to avoid areas of known or suspected contamination. The analyses performed on the groundwater samples used relatively high detection limits and did not include all Target Analyte List (TAL) total or dissolved metals analyses. Neither surface soil nor shallow subsurface soil samples were collected. The subsurface soil samples collected were from below the water table adjacent to the screened interval of each well. None of the data were validated.

CH2M HILL completed an additional background investigation for JEB Little Creek in December 2000 (CH2M HILL, 2001b). The objective of the investigation was to establish the background concentrations of metals, pesticides, and polycyclic aromatic hydrocarbons (PAHs) in surface and subsurface soil and groundwater for use in comparison to ER program site data to better identify release-related COCs. The statistical calculations for both soil and groundwater chemical concentrations included upper tolerance limits (UTLs) and 95 percent confidence intervals, which are used for comparison in the risk screening process.

Background soil samples were collected at non-impacted areas that represent underlying hydrogeologic conditions at JEB Little Creek and areas indicative of anthropogenic background conditions. These areas included fill areas comprised of dredged sediments and past agricultural land use areas where pesticides may have been used. A total of 29 surface and 29 subsurface soil samples were collected during the investigation. Analytical data from background soils represent surface and subsurface soils in fill, urban, and native soil areas. Background water quality samples were collected in January 2000 at six existing background wells, one newly installed well, and three wells located upgradient of base ER sites.

In September 2000, a technical memorandum was prepared in response to a USEPA comment pertaining to evaluating potential seasonal fluctuations in groundwater quality (CH2M HILL, 2003b). In the summer of 2001,

background monitoring wells were sampled. The analytical data from the winter 2000 and summer 2001 sampling events were compared, and no significant differences were identified. It was noted that substantial differences in groundwater concentrations were observed for specific parameters in specific locations. Background UTLs were reassessed as part of the 2001 technical memorandum, and more conservative UTLs were presented for arsenic (4 micrograms per liter [µg/L]) and iron (17,100 µg/L).

2.3.9 SWMU/Installation Restoration Summary

In June 2000, the former NAB Little Creek summarized all available information on the 147 SWMUs, 8 AOCs, and 17 IR sites at the facility (NAB Little Creek, 2000). The report included photographs and information obtained from the RFA and RRRS. **Table 2-1** provides the correlated listing of JEB Little Creek sites, SWMUs, and AOCs.

2.4 Site-Specific Investigations and Remediation Activities

The SMP is updated annually to revise project schedules and provide current site investigationSI information for the JEB Little Creek CERCLA ER Program. The review and comment periods are based on FFA guidelines. The schedules derived from these guidelines assume informal dispute resolution. Flow charts depicting the FFA process are included as **Tables 2-4, 2-5,** and **2-6**.

The Navy will conduct CERLCA Five-year Reviews for sites with remedial actionsRAs documented in a Record of Decision (ROD). The first Five-year Review was finalized in March 2009 and included Sites 9, 10, 11, 12, and 13, which were sites with a signed ROD at the time the Five-year Review was completed (CH2M HILL, 2009e).2009d). The second Five-year Review was finalized in March 2014 and included Sites 7, 9, 10, 11, 11a, 12, and 13, which were sites with a signed ROD at the time the second Five-year Review was completed (CH2M HILL, 2014b).

The schedule for base-wide activities is provided on **Table 2-7**.

The sitesonly site remaining that is currently under investigation in the ER Program at JEB Little Creek includeis SWMU 3 and SWMU 7b. The remedy for each of these sitesthis site will ultimately be documented in a ROD. A ROD was signed for Site 11a in September 2011 and implementation of the remedy began in November 2012. Sites with a ROD and remedy-in-place (RIP) include Sites 7, 9, 10, 11, 11a, 12 and 13. These sites are depicted on **Figure 2-1.** Response is complete for Site 8, SWMU 7a, SWMU 7b, and SWMU 8. These sites are discussed in Section 2.4.43. The site descriptions and remediation activities scheduled for these sites are detailed below.

2.4.1 Remedial Investigation/Feasibility Study Sites

New SWMU 3 (SWMU 111)—Pier 10 Sandblast Yard

"New" SWMU 3 (formerly SWMU 111), the Pier 10 Sandblast Yard, is located in a developed area on the west side of Little Creek Harbor (**Figure 2-2**), and was used for sandblasting boats between 1962 and 1984. After 1984, anchors and anchor chains were sandblasted at the site. Until 1995, sandblasting took place on a concrete pad located on the west side of Building 1263. The sandblast material was periodically removed from the site for disposal following extraction procedure (EP) toxicity testing indicating the residue was not hazardous. Paint chips and grit covered the unpaved ground south of the concrete pad to the water's edge and the near shore sediments of Little Creek Channel. In 1982, a fence was installed around the sandblasting area to limit access to the site and to prevent windblown sandblast materials from migrating outside of the fenced area. In 1993, site photos indicated that the sandblast area had been covered with asphalt, except for a small area to the west of the sandblasting pad. Little or no vegetation covers this unpaved area. In approximately 1995, a new sandblasting area was constructed in the northwest corner of the site. This new area consisted of a concrete pad surrounded by a 4- to 5-foot concrete wall. A new indoor sandblasting facility., Building CB125, located south of Desert Cove, CB125 near SWMU 7, was constructed in 1996 and sandblasting activities at SWMU 3 ceased (**Figure 2-3**).

Within the former sandblasting area, surface water drainage flows toward a catch basin. Some runoff from other areas of the site may flow into Little Creek Channel, located on the east side of SWMU 3. Little Creek Channel is not used for recreational purposes, but JEB Little Creek boat traffic is present and practice maneuvers are conducted in the area. A picnic area was located in the southwest portion of SWMU 3 is usedfor use by personnel from Building 1265. TheIn April 1999, the picnic area was covered by 3 inches of soil and sod in April 1999 to

minimize any potential exposure to the visible sandblast materials. The picnic area was demolished during completion of the SWMU 3 Time-Critical Removal Action (TCRA) in 2014.

Groundwater in the ~~Columbia Aquifer~~shallow aquifer flows generally in a southeast direction and follows the topography of the site. Groundwater discharges to Little Creek Channel to the east and south of SWMU 3. The low groundwater gradient and shallow groundwater table at SWMU 3 indicate that the ~~Columbia Aquifer~~shallow aquifer is directly connected to the surface water in Little Creek ~~Channel~~Harbor.

As part of the RRRS, soil and groundwater sampling was conducted at SWMU 3. The results from the soil sampling conducted at SWMU 3 resulted in a high relative risk ranking as defined by the Navy's RRRS. Arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, nickel, and zinc were detected in soils. Relatively high concentrations of metals were detected in the groundwater; however, these results were for total (unfiltered) metals from temporary wells, which typically yield high levels of metals.

In September 1998, as part of the SI, groundwater samples were collected from four newly installed wells and one existing upgradient well, surface and subsurface soil samples were collected from 10 locations, and sediment samples were collected from four locations in Little Creek Harbor (CH2M HILL, 1999b). The Final SI report, dated December 1999, also included a qualitative HHRA. RI field investigation activities were conducted for SWMU 3 in August and September of 2002. During the investigation, three additional monitoring wells were installed at SWMU 3. Surface soil, subsurface soil, surface water, groundwater, and sediment samples were collected to fill data gaps and confirm results of previous investigations. The RI/HHRA/ERA Report was finalized in August 2005 and recommended further investigation for soil, groundwater, and sediment to evaluate potential human health and ecological risk (CH2M HILL, 2005k).

Based on the results of the RI/HHRA/ERA, an Supplemental Remedial Investigation (SRI) was conducted in January and February 2007 to delineate the extent of volatile organic compounds (VOCs) in groundwater, reevaluate human health risk associated with VOCs and metals in groundwater, and delineate the lateral and vertical extent of abrasive blast material (ABM) in sediment. Thirteen membrane interface probe (MIP) data points and 23 direct-push technology (DPT) groundwater samples were used to delineate the extent of VOCs in groundwater at SWMU- 3. Seven new monitoring wells were installed (five boundary wells and two high concentrations wells~~);~~) at locations based on DPT groundwater results; the seven new and eight existing monitoring wells were sampled for VOCs and metals ~~based on DPT groundwater results~~. Aquifer slug testing was performed and three subsurface soil samples were collected to aid in the evaluation of remedial alternatives. Inconsistencies noted between MIP/DPT and monitoring well sample data necessitated that an additional round of groundwater samples be collected from all site monitoring wells in September 2007. Groundwater results were consistent with groundwater results collected from the monitoring wells in February 2007.

Surface and subsurface sediment samples were collected in Little Creek Harbor along transects using ponar and vibracore technologies to delineate the extent of ABM in sediment. Samples were visually examined for ABM content and analyzed for ecological COCs (copper, lead, mercury, nickel, tin, and zinc) identified in the 2002 ERA. With the exception of the northern boundary and the marina to the south, the lateral ~~and vertical~~ extent of ABM in sediment was defined. As a part of SRI activities, additional surface sediment samples were collected in July 2007 from Little Creek Cove for use as urban background values. Results of the ERA concluded ABM was significantly correlated with the metals COCs in surface sediments and is a good indicator of site influence for defining the spatial extent of contamination, and of unacceptable ecological risks. The Tier I Partnering Team agreed toxicological testing was not warranted at the site and sediment preliminary remediation goals (PRGs) would be developed using risk-based standards, taking percent ABM and urban background values into account.

The SRI/HHRA/ERA was finalized in August 2009 (CH2M HILL, ~~2009h). NFA was recommended for soil and surface water. An FS was recommended to address COCs in groundwater and sediment (to include the riprap along the shoreline). A subsequent Final Technical Memorandum evaluating future potable use of groundwater and discharge of groundwater to surface water at the site (CH2M HILL, 2011i) was submitted summarizing the Tier I Partnering Team's NFA recommendation for groundwater. The Tier I Partnering Team agreed that the potable use of groundwater was not a viable exposure scenario due to the site's hydrogeologic conditions (i.e., groundwater~~

underlying SWMU 3 is situated within a layer of fill material [dredge spoils] and is representative of a freshwater/seawater transition zone), there are no potential for downgradient users, and USEPA does not allow for potable use of groundwater characterized as having a high-to-intermediate degree of interconnection with an adjacent surface water body.2009g). NFA was recommended for soil and surface water. An FS was recommended to address human health risk associated with hypothetical future potable use of groundwater (VOCs and metals) and ecological risks associated with metals in sediment (to include the riprap along the shoreline).

Pre-FS groundwater sampling was conducted in January and September 2008 to collect additional data for the evaluation of remedial alternatives in an FS. A Work Plan for Pre-FS Sediment Sampling was finalized in February 2009 (CH2M HILL, 2009a) and a Vertical Removal Boundary Delineation and Waste Characterization Sediment Sampling Work Plan and Sampling and Analysis Plan (SAP) were finalized in December 2009 (CH2M HILL, 2009j2009i). The sediment delineation sampling was completed as two separate events in 2009 to further define the horizontal and vertical extent of ABM and associated metals contamination requiring CERCLA remedial action.RA. A non-CERCLA related petroleum layer, noted during previous investigations, was concurrently delimited during the vertical delineation sampling event to determine its impact on the remedial alternatives at the site.

Following completion of the vertical delineation and a preliminary review of potential remedial alternatives, the Tier I Partnering Team agreed that a more comprehensive understanding of the benthic community was required. Benthic invertebrate sampling was conducted in August 2010 per the draft SAP, later finalized in October 2010 (CH2M HILL, 2010f). 2010g). Results were documented in a Benthic Invertebrate Evaluation Technical Memorandum finalized in December 2012 (CH2M HILL, 2012k2012i).

A Risk Assessment Update reviewing the site conceptual model and evaluating potential future potable use of groundwater and discharge of groundwater to surface water at the site was finalized in July 2013 (CH2M HILL, 2011i). The Tier I Partnering Team agreed the potable use of groundwater was not a viable exposure scenario at SWMU 3 due to the site's hydrogeologic conditions (i.e., groundwater underlying SWMU 3 is situated within a layer of fill material [dredge spoils] and is representative of a freshwater/seawater transition zone), there is no potential for potable water users downgradient of the site, and USEPA does not allow for potable use of groundwater characterized as having a high-to-intermediate degree of interconnection with an adjacent surface water body. Therefore, the residential and industrial worker potable use receptor scenarios evaluated as part of the RI/HHRA/ERA and SRI/HHRA/ERA are not applicable exposure pathways at SWMU 3. Although potable use is not an applicable exposure pathway at SWMU 3, VDEQ's antidegradation policy (9 VAC 25-280-30), considers all groundwater a potential potable resource and requires that all groundwater be restored to beneficial use or that present and potential future uses of groundwater be preserved and protected. Therefore, because concentrations of contaminants above maximum contaminant levels (MCLs) were detected, at a minimum, land use restrictions prohibiting the potable use of shallow groundwater at SWMU 3 until it is demonstrated that concentrations of contaminants are below the MCLs would be necessary for the protection of potential future potable use receptors. An evaluation of human health and ecological risks associated with groundwater discharge to Little Creek Harbor concluded that discharge of groundwater (based upon the chemical concentrations from existing data) does not represent an unacceptable incremental increase in risks to aquatic receptors in Little Creek Harbor. Therefore, the Navy and USEPA, in consultation with VDEQ, agreed that no further evaluation of the groundwater to surface water transport pathway at SWMU 3 is warranted.

A second risk assessment update was finalized in June 2013 to address potential future vapor intrusion risk associated with VOCs detected in shallow groundwater (CH2M HILL, 2013e). There is no current pathway for vapor intrusion at SWMU 3. Groundwater data collected as part of the SRI in 2007 were utilized to calculate potential risks associated with future vapor intrusion pathways. Potentially unacceptable vapor intrusion(?) risks associated with trichloroethene (TCE) and vinyl chloride were identified based on maximum detected concentrations of VOCs in groundwater. However, those calculated risks were representative of site conditions in 2007. Based upon conceptual site model (CSM) considerations, and the proximity of the historic elevated TCE and vinyl chloride concentrations to the adjacent shoreline, elevated concentrations of these chemicals from 2007 are expected to have undergone natural biodegradation as well as advection with groundwater flow, and have likely

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discharged to Little Creek Harbor since 2007. As a result, the calculated vapor intrusion risks are likely an overestimation of actual potential risks; therefore, the Navy and USEPA, in consultation with VDEQ, agreed that NA is warranted to address vapor intrusion at SWMU 3.

As a result of scheduled removal of the floating drydock and associated anchoring system located within the site boundary, as well as a planned maintenance dredge effort north of the site, the Tier I Partnering Team agreed to develop an Engineering Evaluation/Cost Analysis (EE/CA) for completion of a Non-Time-Critical Removal Action (NTCRA) to address contaminated sediment in portions of the site during the scheduled maintenance. An EE/CA was finalized in December 2012 and identified mechanical dredging, offsite solidification, upland disposal, and replacement with clean fill as the preferred removal alternative (CH2M HILL, ~~2012l~~2012j). The Action Memorandum (AM) for the NTCRA was signed in December 2012 (CH2M HILL, ~~2012m~~2012k). Prior to implementation of the removal action, pre-removal action confirmation sampling was conducted to determine the vertical extent of removal required to mitigate ecological risks within the CERCLA sediment remediation area (CH2M HILL, ~~2013d~~2013c). The NTCRA to address contaminated sediments in the area surrounding the drydock and anchoring system was ~~initiated~~completed in ~~February~~May 2013 ~~and is currently ongoing. Following completion of NTCRA activities~~. In September 2013, a Construction Summary Technical Memorandum ~~is scheduled~~was finalized to ~~be developed in FY2013.~~document successful completion of NTCRA activities and mitigation of ecological risks within the removal area (CH2M HILL, 2013g).

To address soil and remaining sediment at SWMU 3, ~~a TCRA is scheduled~~ an AM for the completion ~~in FY2013. A draft AM~~ of a TCRA was ~~distributed for regulatory review in March~~signed in June 2013 ~~(CH2MHILL, 2013e) outlining~~. The AM outlined excavation, where feasible, offsite disposal, and site restoration to include construction of a stormwater management retention feature, sediment amendment, and/or placement of a clean sand layer as the proposed removal action~~.~~ (CH2M HILL, 2013d). A second TCRA AM to document a partial change in scope (inclusion of sediment dredging where feasible) of the response action was signed in December 2013 (CH2M HILL, 2013l). The TCRA was completed in March 2014. The draft final Construction Completion Report (CCR) was submitted in June 2014 (Tetra Tech, 2014). Following implementation of the TCRA, the Tier I Partnering Team agreed that no further action ~~will be~~is required for soil and sediment at SWMU 3 ~~and a Construction Completion Report (CCR) will be developed~~.

~~To address potential future vapor intrusion risk associated with VOCs detected in shallow groundwater, a risk assessment update was conducted.~~Although no potentially unacceptable risks associated with exposure to contamination in groundwater were identified under the current site conceptual model; previous investigations have identified the presence of VOCs in shallow groundwater at concentrations above MCLs. Therefore, to address VOCs above the MCL and the hypothetical future potential human health risks that may result from a change in the current CSM, a draft Focused Feasibility Study (FFS) was submitted in May 2014 (CH2M HILL, 2014c). Two remedial alternatives were selected for comparative analysis: (1) NA; and (2) natural attenuation and land use controls (LUCs). To aid in evaluating the viability of natural attenuation at SWMU 3, additional groundwater sampling is scheduled to be completed in early FY 2015.

~~There is no current pathway for vapor intrusion at SWMU 3. Groundwater data collected as part of the SRI in 2007 were utilized to calculate potential risks associated with future vapor intrusion pathways. A draft Technical Memorandum documenting the results of the risk assessment update was submitted for regulatory review in April 2013. An NFA Proposed Plan and Record of Decision are scheduled for FY2014.~~

The 5-year schedule for SWMU 3 is presented on **Table 2-8**. Planned activities at SWMU 3 consist of the following:

- ~~TCRA~~
- ~~TCRA CCR~~
- Pre-FS Groundwater Sampling UFP SAP
- Pre-FS Groundwater Sampling Event
- FS
- Proposed Plan and ROD

SWMU 7b—Small Boats Sandblast Yard (Desert Cove Sediment portion of SWMU 7)

"New" SWMU 7, the Small Boats Sandblast Yard, is located along piers 36 through 55 at Desert Cove (**Figure 2-3**). This SWMU is also referred to as SWMU 137 in the RFA and was previously identified as part of IR Site 2 during the IAS. The area of SWMU 7 was used to sandblast and paint ships until 1996, when sandblasting activities were moved to an indoor facility. The Small Boats Sandblast Yard was used to store spent ABM while awaiting characterization EP toxicity test results. Approximately 4,000 cubic yards (yd^3) of ABM from sandblasting activities generated between 1960 and 1982 were stored in the yard.

No release controls have been identified for this unit. Based on visual site inspections conducted by Earth Technology Corporation in 1988, releases of spent grit and oily substances to the soil and Desert Cove have occurred in the Small Boats Sandblast Yard. According to the Navy's responses to the RFA, oil-stained soil in the area has been removed. ABM is currently present in the compound near CB125, CB317, and CB318. A small amount of ABM was also found west of Building 3869.

The southwestern portion of SWMU 7 is the site of the new paint blast facility, CB125. Before construction of the building, NAVFAC Atlantic contracted with ATEC Environmental to conduct a soil and groundwater investigation. Five soil locations were sampled. The samples were analyzed for total metals and EP toxicity metals. ATEC noted in their summary report that the only metal detected above the method detection limit (MDL) in the EP toxicity analysis was zinc at 3.4 parts per million (ppm). This amount is below the hazardous waste characteristic. In January 1993, three soil and three groundwater samples were collected from wells installed at the site. Soil samples were analyzed for Toxicity Characteristic Leachate Procedure (TCLP) metals, and groundwater was analyzed for total metals. These samples were taken in the immediate area of the new sand blasting facility CB125. The soil was found to be below the hazardous waste characteristic. Arsenic (maximum = 287 micrograms per liter [µg/L]) and cadmium (maximum = 16 µg/L) were the only metals detected in groundwater. A site reconnaissance was conducted in 1999 for the visual presence of ABM. The presence of ABM was noted in the area of CB125, and trace amounts were observed in the area along small boat piers 51 through 44.

A Final SI report for SWMU 7 was submitted in August 2001 (CH2M HILL, 2001g) with a corresponding Screening Ecological Risk Assessment (SERA) completed in January 2001 (CH2M HILL, 2001a). The SI field activities conducted in May 2000 included the collection and analysis of surface and subsurface soil, sediment, and groundwater samples. Three monitoring wells were installed at SWMU 7, and 28 co-located surface and subsurface samples were collected. Five sediment samples were collected along the boat piers in Desert Cove. Co-located surface and subsurface samples were analyzed for TAL metals and PAHs. Soil samples collected during monitoring well installation were analyzed for Target Compound List (TCL) organic compounds and TAL metals. All sediment samples were analyzed for TAL metals, PAHs, grain size, pH, and total organic carbon (TOC). One sediment sample was also analyzed for TCL organics. All groundwater samples were analyzed for TCL organic compounds and TAL metals. Analytical results were qualitatively evaluated through a comparison with USEPA Region III risk-based concentrations (RBCs), VDEQ standards, maximum contaminant levels (MCLs), and to background levels established for JEB Little Creek.

Groundwater, surface soil, subsurface soil, and sediment samples were collected as part of an RI in August and September 2002. During the investigation, three additional monitoring wells were installed at the site. The RI/HHRA/ERA concluded that there were no overall human health or ecological risks in soil or groundwater at the SWMU (CH2M HILL, 2004p); however, the presence of ABM residues in the northern portion of the site was a potential continuing source of contaminants to sediment in Desert Cove. During development of the RI, a Navy Military Construction (MILCON) project to demolish and replace the existing piers and dredge limited areas of Desert Cove was being planned. Due to the possibility that the project may result in the removal of contaminated sediments that exceed acceptable levels, the RI recommended that further site sediment evaluation be postponed until project completion.

Although there was no overall human health risk in surface soil at SWMU 7, one surface soil result (LW07-SS24) indicated lead at concentrations above the USEPA Region III residential child soil screening value (400 milligrams per kilogram [mg/kg]) as determined by the Integrated Exposure Uptake Biokinetic (IEUBK) model. To eliminate the potential human health exposure risk, the lead-impacted area was delineated for removal and recorded in a

Technical Memorandum in February 2004 (CH2M HILL, 2004a). The results of the delineation activities were incorporated into the EE/CA for SWMU 7 (and SWMU 8), which was finalized in June 2004 (CH2M HILL, 2004g).

The Interim Removal Action (IRA) for surface soil at SWMU 7 was completed in September of 2004 and successfully eliminated the potential human health exposure risk for terrestrial media at SWMU 7. Subsequently, NAVFAC, USEPA, and VDEQ agreed to separate the terrestrial and aquatic portions of the site to best manage the remediation process. The terrestrial portion of the site was termed SWMU 7a and the aquatic portion of the site was termed SWMU 7b. A Site Closeout Report was completed for SWMU 7 in December 2004 (CH2M HILL, 2004q). The Proposed Remedial Action Plan for SWMU 7a was finalized in April 2005 (CH2M HILL, 2005e) and a NFA ROD was signed in June 2005 (CH2M HILL, 2005i). Future documentation and remedial activities beyond the Final RI/HHRA/ERA will refer to SWMU 7b as the aquatic portion of the site (sediment and surface water of Desert Cove).

A MILCON project was completed in 2008 that included demolition of existing piers 44-51 and the construction of six new piers along the eastern edge of Desert Cove with a corresponding new quay wall along the eastern and southern edges of the cove. Sediment containing ABM remained in place behind the metal sheet piling of the newly installed quay wall, thereby removing most of the exposure pathway for ecological receptors. Institutional controls will need to be considered when moving forward with the site. A revised ERA work plan was finalized in November 2009 detailing sampling procedures for sediment remaining outboard of the new quay wall. Sediment sampling was conducted in November 2009 to quantify potential ecological risks in sediment following the MILCON action. To further develop the site conceptual site model (CSM), benthic invertebrate sampling was conducted in August 2010 per the draft SAP, later finalized in October 2010 (CH2M HILL, 2010f). Results of the post-MILCON evaluation indicated potentially unacceptable ecological risks to the benthic invertebrate community may be present within limited portions of SWMU 7b (northeast corner of the Pier Area) (CH2M HILL, 2012a).

In conjunction with the scheduled maintenance dredge and SWMU 3 NTCRA, the Tier I Partnering Team agreed to conduct a NTCRA to address contaminated sediment at SWMU 7b. An EE/CA was finalized in January 2013 and identified mechanical dredging, offsite solidification, upland disposal, and replacement with clean fill as the preferred removal alternative (CH2M HILL, 2013a). The Action Memorandum (AM) for the NTCRA was signed in January 2013 (CH2M HILL, 2013b). Prior to implementation of the removal action, pre-removal action confirmation sampling was conducted to determine the lateral and vertical extents of removal required to mitigate ecological risks at SWMU 7b (CH2M HILL, 2013d). The NTCRA was initiated in February 2013 and is currently ongoing. Following completion of NTCRA activities, no further action for SWMU 7b will be required. A Construction Summary Technical Memorandum is scheduled to be developed in FY2013, followed by a Proposed Plan and ROD.

The schedule for SWMU 7b is presented in **Table 2-9**. Planned activities at SWMU 7b consist of the following:

- Proposed Plan and ROD

2.4.2 Record of Decision Sites Requiring Action

Site 11a—Building 3033 Former Waste Oil Tank

Site 11a, located north of Site 11 (**Figure 2-4**), was identified during the 1998 SRI at Site 11 when trichloroethene (TCE), a type of VOC, was detected in the upgradient monitoring well LS11-MW16D at a concentration of 100 µg/L (CH2M HILL, 2004i). Groundwater samples were collected using DPT in 2001 and sample results confirmed the presence of elevated TCE concentrations in this area. Based on these results, the area north of Site 11 was identified as AOC Site 11a. Two former buildings, Buildings 3033 and 3034, had been located at the site. No documented releases were associated with former Building 3034, which was located in the grass-covered field and was used as a garden supply center. Historical records indicated the presence of a former underground waste oil tank associated with Building 3033, a 12-bay vehicle repair facility located immediately south of the current barracks building. The tank was reportedly excavated and removed in 1988 under the Underground Storage Tank (UST) Program; however, documentation of tank closure is not available. The tank was identified as SWMU 60 in the FFA and SWMU/IR Summary Report and was closed out with NA following a desktop audit prior to JEB Little

Creek's placement on the NPL. The contents of the tank were not documented in these reports. However, groundwater analytical data and MIP results indicated high VOC concentrations in the shallow portion of the aquifer near the area of the former waste oil tank.

A soil and groundwater investigation was conducted as part of an SI in July 2002 and included field screening for TCE, confirmation sampling, monitoring well installation, and groundwater sampling (CH2M HILL, 2003d). The investigation results confirmed the presence of a TCE plume in groundwater with higher concentrations at the bottom of the Columbia Aquifer. TCE concentrations in soil did not exceed regulatory risk-based screening criteria.

A MIP investigation was conducted in September 2003 to delineate the chlorinated VOC plume (CH2M HILL, 2003e). During the MIP investigation, a potential source area of elevated tetrachloroethene (PCE) concentrations in the unsaturated zone was identified. Subsequent groundwater samples were collected to confirm MIP results. Monitoring wells were installed and sampled using passive diffusion bags in February 2004 at various depths within the Columbia Aquifer to determine both the horizontal and vertical stratification of the chlorinated VOC plume (CH2M HILL, 2004e). Results of the MIP investigation and groundwater sampling activities were used to develop a Treatability Study (TS) Work Plan consisting of *in situ* chemical oxidation (ISCO) and post-injection groundwater monitoring (CH2M HILL, 2005a). Implementation of the TS for ISCO was completed in March 2005 and was followed by long-term monitoring (LTM) of the groundwater in April 2005, July 2005, and November 2005. Groundwater monitoring data provided in the TS Report indicated mixed results on the effectiveness of ISCO in reducing VOC concentrations (CH2M HILL, 2006e). Incomplete distribution of reagent in the aquifer likely contributed to the lack of significant VOC reduction across the site. The Tier I Partnering Team agreed that an RI was warranted for the site.

Soil and groundwater samples were collected and analyzed as part of the RI, conducted in September/October 2007, to assess the nature and extent of contamination at the site and quantify potential human health and ecological risks. The draft final RI report was finalized in July 2010 (CH2M HILL, 2010c). The RI recommended further evaluation of possible vapor intrusion into Building 3606 and recommended additional confirmation of contaminants in one monitoring well (LS11A-MW20D). The RI further recommended that an FS be conducted to develop remedial action objectives (RAOs) and evaluate remedial alternatives to mitigate the potentially unacceptable site-related risks posed by the COCs in groundwater. NFA is warranted for soil associated with Site 11a.

In response to RI recommendations, an RI Addendum was completed to assess the potential for vapor intrusion in Building 3606 (CH2M HILL, 2011c). Results from the sub-slab soil vapor samples collected in November 2009 exceeded screening criteria. Subsequent sub-slab vapor and indoor air samples were collected in Building 3606 and adjacent Building 3606a in March 2010. Similar to the November 2009 analytical results, the analytical results from the sub-slab vapor samples, as well as indoor air samples, collected in March 2010 exceeded screening criteria. A screening level HHRA concluded concentrations of VOCs did not pose unacceptable risk associated with vapor intrusion in existing buildings under current site conditions; however future degradation of existing building conditions may increase the potential for risk. Long-term monitoring of the vapor intrusion pathway as part of the shallow groundwater remedy was recommended.

Due to a detection of pentachlorophenol (PCP) in a groundwater sample from monitoring well LS11A-MW20D during the RI sampling event in 2007 (previously collected groundwater samples from this monitoring well were not analyzed for PCP), a confirmation round of groundwater samples was collected from all Site 11a monitoring wells in September 2009. PCP was not detected in any of the groundwater samples collected during the September 2009 sampling event. Based on results of the groundwater samples, it was determined there was no PCP groundwater plume and PCP should not be considered a COC.

A final FS was submitted in June 2011(CH2M HILL, 2011d) and the Proposed Plan was finalized in August 2011 (CH2M HILL, 2011f) recommending enhanced reductive dechlorination (ERD), land use controls (LUCs), and LTM as the preferred remedial alternative for Site 11a. The ROD was signed in September 2011 (CH2M HILL, 2011g). A 90% Basis of Design (CH2M HILL, 2011h) and RA Work Plan UFP SAP (Osage, 2012a) were submitted in August

~~2011, and remedial action began in March 2012 with the installation of 5 new monitoring wells and baseline groundwater sampling. Based on the results of the baseline groundwater sampling, a 100% Basis of Design (Ch2M HILL, 2012j) and Revised Final (RA) Work Plan UFP SAP (Osage, 2012b) were submitted in October 2012. Injection of emulsified vegetable oil was performed in November 2012 and a draft RA CCR was submitted for regulatory review in March 2013 (Osage, 2013). Performance monitoring is ongoing and results will be documented in a Remedy Effectiveness Evaluation.~~

~~The LUC RD was finalized in April 2013 (Navy, 2013). A Consensus Agreement is scheduled to be signed by the Tier I Partnering Team in FY 2013 to address changes in LUC objectives language between the ROD and final LUC RD. The LUCs recorded in the LUC RD are part of the remedy and will be implemented, maintained, enforced, and reported on in accordance with the ROD and Sections 3.0 and 4.0 of the LUC RD. LUCs will be maintained within the LUC boundary at Site 11a until concentrations of VOCs in groundwater are reduced to levels that allow unlimited use and unrestricted exposure. An IRACR and LTM Plan are scheduled for FY2014.~~

~~The 5-year schedule for Site 11a is presented in **Table 2-10**. Planned activities at Site 11a consist of the following:~~

- ~~Remedy Effectiveness Evaluation~~
- ~~IRACR~~
- ~~LTM UFP SAP~~
- ~~LTM~~

~~2.4.3~~2.4.2 Remedy-in-Place Sites

RODs have been signed for Sites 7, 9, 10, 11, 11a, 12 and 13, and the selected remedies have been implemented; however, not all remedial action objectives (RAOs) have been achieved. Long-term monitoring (LTM) and LUC inspections for Sites 7, 9, 10, 11, 11a, 12 and 13 are ongoing to ensure the remedies continue to be protective of human health and the environment.

JEB Little Creek has elected to follow Navy recommendations for conducting an installation-wide Five-year Review for all sites with remedies in place. The Five-year Review is required 5 years from the initiation of the first ~~remedial action~~RA where hazardous substances, pollutants, or contaminants remain onsite above levels that allow for unlimited use and unrestricted exposure. The triggering action of the statutory review process was the signature of the Sites 9 and 10 ROD in December 2003 by the Navy. The first Five-year Review for JEB Little Creek was signed in March 2009~~.~~ and included those sites with a signed ROD at the time the document was completed (Sites 9, 10, 11, 12, and 13). The second Five-year Review for JEB Little Creek was signed in March 2014. The sites with signed RODs when the second Five-year Review was completed, and therefore the sites included in the second Five-year Review, were Sites 7, 9, 10, 11, 11a, 12, and 13. The findings from the completed Five-year ~~Review~~Reviews are detailed in the site-specific sections below. The next Five-year Review is scheduled for ~~2014~~2019.

Site 7—Amphibious Base Landfill

Site 7 Amphibious Base Landfill (also referred to as SWMUs 123 through 126 in the RFA) is approximately 31 acres and is located in the south-central portion of the installation. The area is bounded on the north by Little Creek Cove, on the east by Helicopter Road, on the south by Amphibious Drive and the Hampton Roads Sanitation District (HRSD) sewage treatment plant, and on the west by an undeveloped area and an ordnance magazine (**Figure 2-~~5~~3**). A chain link fence also borders the site along Helicopter Road and Amphibious Drive and provides restricted access through locked gates. Restricted access signs are in place around the perimeter of the site. Site 7 was originally an arm of Little Creek Cove that was filled with dredge spoils before its use as a landfill. According to the IAS, the landfill operated between 1962 and 1979 and initially functioned as a trench-type landfill with open burning of refuse in the trenches. The trenches were excavated to the depth at which groundwater filled the trench. Cover was applied as necessary to maintain traction for the vehicles involved in the operations. The landfill was constructed so that the central portion was a broad flat area bounded by gentle slopes on all sides. Erosion-prone areas of the site were reinforced on each side of the canal that crosses the west side of the site.

The IAS estimated the volume of waste (excluding dredge spoils) in the landfill to be approximately 500,000 cubic yards (yd^3). Most of the waste is presumed to be composed of non-hazardous solid waste from base housing and other residential and commercial activities at the base. Specific records documenting the types and quantities of waste placed in the Amphibious Base Landfill are not available. Because the landfill received all wastes generated by JEB Little Creek during its operation, it likely received potentially hazardous materials.

A non-conforming permit (No. 276) was issued in 1979 to allow disposal on an interim basis; the permit was terminated in 1982, and the landfill was considered 'closed' by the state. After closure, the landfill area continued to be used as a metal collection and transfer site, a temporary storage area for wastes, and a burn area for scrap wood and trees. Open burning was halted in 1984, and waste storage activities were moved elsewhere in 1994. In 1994, the landfill was reportedly covered with approximately 24 inches of compacted soil and 2 to 3 inches of topsoil cover. A vegetative cover was also established to mitigate contact with surface soil in 1994. The thickness of the soil cover was confirmed by soil boring activities conducted in preparation for the soil cover constructed in 1998.

The RVS concluded that the landfill was not releasing contaminants to the groundwater, but recommended that additional groundwater, surface water, and sediment sampling be performed. This additional sampling was completed as part of the IRI. The sampling results indicated that the landfill was not releasing contaminants to the groundwater, thus confirming the conclusions of the RVS.

Site 7 was one of the six sites included in the aforementioned RI/FS that was conducted by FWES in November 1994 (FWES, 1994b). Eight surface soil, five subsurface soil, nine groundwater, six surface water, and six sediment samples were collected at Site 7. Groundwater in the shallow Columbia Aquifer beneath Site 7 flows predominantly northward toward the low-lying marsh and Little Creek Cove. A tidal study was conducted as part of the RI: the results indicated that groundwater may flow toward the tidally influenced western canal in localized areas and that the rate of groundwater-to-surface water discharge increases in response to a low tide. A Final FS was also completed for Site 7 by FWES in October 1997 (FWES, 1997). The Final FS identified remedial alternatives to reduce potential human health and environmental risks associated with the various COCs identified at Site 7. A preferred remedial alternative was identified in the October 1997 Proposed Remedial Action Plan (PRAP) (CH2M HILL, 1997). The preferred remedial alternative was institutional controls (ICs) that consisted of removing visible debris from the landfill and placing topsoil in selected areas of the landfill where the existing cover was insufficient, construction of a new perimeter fence, and performing semiannual monitoring.

The Navy signed the Final Decision Document (DD) in January 1998 (CH2M HILL, 1998a). Subsequently, a Remedial Design (RD) and RA were completed in June 1998. The remedy included the removal of 610 yd^3 of debris along the landfill shoreline. Approximately 8,640 yd^3 of clean fill and 11,260 yd^3 of topsoil were placed on the landfill during the RA. A 12- to 18-inch-thick fill layer was placed over some areas of the landfill where cover was inadequate, and a 6- to 8-inch topsoil cover was placed over the entire landfill area (OHM, 1999a). Following completion of the RA, the landfill waste was located at an average of 30 inches below ground surface (bgs), and the appearance of the landfill ranged from small stands of mature trees on the western portion of the site to tall, thick grasses in the central and eastern portions of the site. The area bordering Little Creek Cove was vegetated, with numerous trees, dense brush, and tall grasses.

LTM of groundwater, surface water, and sediment was initiated in June 1998. An LTM letter report was submitted to the Navy, USEPA, and VDEQ following each round of monitoring. The first 11 rounds of data collected between 1998 and 2004 were similar to results reported in the RI/FS (FWES, 1994b); therefore, the Navy, USEPA, and VDEQ agreed that LTM would be discontinued until a ROD was completed for the site.

As part of the RI/HHRA/ERA, sediment samples were collected to assess potential unacceptable ecological risk in canal sediments located in the western portion of Site 7 (CH2M HILL, 2004m). The ERA, with agreement from USEPA and VDEQ, concluded that if canal sediments were removed, the remaining sediment at Site 7 presented no unacceptable ecological risk. The HHRA concluded that Site 7 posed no unacceptable risks or hazards to human health based on current site use, but that the potable use of groundwater would pose potential unacceptable

human health risk. The RI/HHRA/ERA was finalized in November 2004. An EE/CA was completed in February 2005 to evaluate removal action alternatives for canal sediment at Site 7 (CH2M HILL, 2005d).

A debris survey was conducted in July 2005 to delineate the extent of surface debris at the site and assess the need for maintenance actions to maintain integrity of the existing soil cover (CH2M HILL, 2005m). Based on debris delineation findings, the Navy, USEPA, and VDEQ agreed that soil cover maintenance actions at Site 7 were warranted and surface debris should be removed where practicable. Other recommended actions included moving the southern site fence south towards Amphibious Drive and removing surface debris observed outside of the existing soil cover area, as feasible.

The IRA for canal sediment at Site 7 was completed in February and March of 2007. Additionally, soil cover maintenance activities were completed along the canal as part of the July 2005 debris delineation survey in conjunction with the sediment removal action and were documented in a ~~Construction Completion Report (CCR)~~CCR (JV I, 2008a).

~~A draft Focused Feasibility Study (FFS) was submitted in October 2007 and~~A FFS was finalized in August 2008 outlining the proposed remedy for the Site (soil cover with LUCs and LTM) (CH2M HILL, 2008c). Additional test pitting was conducted to the west of the drainage canal to assess the presence or absence of buried waste. Crane arms, tires, batteries, and metallic debris were observed in this area, primarily on the surface with localized cover; however, there were no indications that landfilling operations consistent with historical practices at Site 7 were conducted in this area. Based on the results of the test pitting activities, the Navy, USEPA, and VDEQ agreed to revise the HHRA to assess potential future residential risk associated with exposure to groundwater. The revised HHRA concluded there were no unacceptable risks to human health from exposure to soil, groundwater, sediment, or surface water at or beyond the boundaries of the landfill. The only potential unacceptable risk to human health or the environment is considered to be exposure to landfill contents. Additionally, the team agreed that surface debris west of the landfill should be removed as part of ongoing operation and maintenance (O&M) activities. Between January and July 2008, O&M activities were conducted in three phases to ensure that 2 feet of soil cover was present over the landfill. During Phases I and II, the northern and eastern portions of the landfill were cleared of vegetation, surface debris was removed, and the ground surface was leveled (JV I, 2008b). During Phase III, an additional 5- acres of landfill cover was placed and seeded to promote the re-growth of vegetation (JV III, 2009).

A Proposed Plan was finalized in February 2009. The preferred alternative identified in the Proposed Plan was maintenance of the existing soil cover, LUCs, and LTM to identify possible future releases and offsite migration of contaminants (CH2M HILL, 2009b). A ROD was finalized for Site 7 in September 2009 (CH2M HILL, ~~2009i~~2009h). LUC requirements for Site 7 were recorded in the LUC RD finalized in December 2010 and outline the completion of annual site inspections to ensure the following LUC objectives are met: 1) prohibit digging into or disturbing the existing soil cover or landfill contents and 2) prohibit the use of the site for residential, child care, elementary or secondary school, or playground facilities (~~DON, 2010). The RACR was signed in July 2012 (CH2M HILL, 2012h). The groundwater LTM SAP was finalized in March 2012 (CH2M HILL, 2012f) and groundwater LTM was conducted in May 2012. Site inspections will continue throughout FY 2013. Results of groundwater LTM were documented in a draft LTM Report submitted for regulatory review in February 2013 (CH2M HILL, 2013c).~~Navy, 2010).

The RACR was signed in July 2012 (CH2M HILL, 2012f). Landfill cover O&M actions were conducted in September 2012 and May 2013 to address site drainage and repair a sinkhole observed during site inspections (CH2M HILL, 2014b). Site inspections will continue throughout FY 2014. The groundwater LTM SAP was finalized in March 2012 (CH2M HILL, 2012d) and groundwater LTM was conducted in May 2012. Results of groundwater LTM were documented in the LTM Report which was finalized in October 2013 (CH2M HILL, 2013j). The LTM Report concluded that the groundwater monitoring results from the May 2012 sampling event were consistent with data collected during pre-ROD LTM and concentrations were not indicative of a site release and offsite migration of groundwater contaminants. The LTM Report recommended the cessation of groundwater LTM, maintaining LUCs in accordance with the LUC RD, conducting landfill integrity inspections, completing Five-Year Reviews, and conducting groundwater sampling in conjunction with Five-year Reviews, as needed.

Site 7 was included in the second Five-year Review of sites with a remedy-in-place (CH2M HILL, 2014b). The Five-year Review determined that the selected remedy is in place, functioning as designed, and is protective of human health and the environment. As a result of the remedy capital costs being below the -30%/+50% range estimated in the ROD, the Five-year Review recommended an evaluation of the changes to remedy costs and preparation of the appropriate documentation, as needed.

The 5-year schedule for Site 7 is presented in **Table 2-119**. Planned activities at Site 7 consist of the following:

- LTM
- Five-year Review

Site 9—Driving Range Landfill and Site 10—Sewage Treatment Plant Landfill.

Site 9, the Driving Range Landfill, is a 6-acre landfill located in the northeast portion of the installation, northwest of the golf course, directly east of the Sewage Treatment Plant Landfill (Site 10) and Hewitt Drive, and approximately 500 ft south of the Chesapeake Bay shoreline (**Figure 2-64**). Landfilling operations occurred from 1950 to 1956. The northern perimeter of the landfill is bounded by a network of sand dunes that parallels the Chesapeake Bay shoreline. Before 1950, the area was a marsh environment adjoining the easternmost arm of Little Creek Cove (Ebasco, 1991a). An incinerator, located on Hewitt Drive opposite the western perimeter of the Driving Range Landfill, was active during the landfill operating period and reportedly burned combustible materials generated by JEB Little Creek. The resulting ash and bypassed materials were disposed of in the Driving Range Landfill. After the incinerator was decommissioned, solid waste from the base was disposed of directly in the landfill. The estimated land disposal volume was 40,000 yd^3 of waste. After landfill operations at the site were terminated, the installation converted the area into a driving range. A berm was constructed using clean fill along the east side of Hewitt Drive, and sewage sludge was brought in along the southern site boundary to enhance growth of the grass. Although precise boundaries for the fill area were not delineated, the boundary of the landfill was considered to generally coincide with that of the driving range (Ebasco, 1991a). The IAS indicated that the Site 9 landfill contents include various hazardous wastes such as polychlorinated biphenyls (PCBs), pesticides, and used motor oil (RGH, 1984). The landfilling methods reportedly entailed the excavation of trenches with a dragline or other heavy equipment. The trenches were filled with waste and backfilled. The depth was likely limited by the depth to the water table, typically within 5 feet of the ground surface. Groundwater in both the Columbia Aquifer and the Yorktown Aquifer at Site 9 flows to the north and discharges into Chesapeake Bay.

Site 10, the Sewage Treatment Plant Landfill, is located in the northeast portion of JEB Little Creek, approximately 500 ft south of the Chesapeake Bay shoreline and due west of the Site 9 Driving Range Landfill (**Figure 2-64**). The landfill is bounded on the north and the west by sand dunes, on the south by 11th Street and recreational facilities that extend onto the landfill area, and on the east by Hewitt Drive. The landfill comprises approximately 18 acres and operated from 1941 until 1968. Existing surface features include a well-vegetated soil cover that has been partially reclaimed for use as baseball diamonds and vegetated sand dunes. Groundwater in both the Columbia Aquifer and the Yorktown Aquifer at Site 10 generally flows to the northwest and discharges into Chesapeake Bay.

The estimated disposal volume at Site 10 was approximately 46,500 yd^3 of waste. The IAS indicated that potentially hazardous constituents and a large quantity of demolition debris were likely disposed of in the landfill; however, the exact quantities of material disposed in the landfill are not documented. Disposal of sewage sludge from the on-site sewage treatment plant, formerly located in the southeast portion of the fill area, continued until 1968 when the treatment plant closed. Landfilling operations began in the southern portion of the area, which included an extension of Desert Cove and then moved northward to the associated marshy lowlands. The bulk of the sewage sludge was disposed of along the northwest perimeter of the landfill, near the base of the sand dunes.

The RVS was completed for Sites 9 and 10 in October 1986 by CH2M HILL. During the RVS, six monitoring wells were installed around the perimeter of Site 9 and eight monitoring wells were installed around the perimeter of Site 10 to facilitate the collection of groundwater samples and hydraulic head data to determine groundwater flow directions. Surface water and sediment samples were collected to investigate impacts on nearby surface water bodies and to determine whether contaminated runoff was migrating from the ER sites. Subsurface soil

samples were collected to delineate the vertical extent of contamination in probable source areas. The results of the RVS sampling activities indicated that little or no contamination was migrating from the Site 9 and Site 10 landfills. However, because the quantity, nature, and extent of contaminants disposed in the landfill were uncertain, there was the potential for unrecognized pathways from the site, and a second round of groundwater sampling was recommended (CH2M HILL, 1986).

Site 9 (referred to as SWMU 24) and Site 10 (referred as SWMUs 25 and 26) were included in the RCRA RFA, conducted by A. T. Kearney in 1989. The RFA recommended no additional action other than the IRI activities planned at Sites 9 and 10.

During the IRI, completed by Ebasco in 1991, a second round of groundwater sampling was conducted at Sites 9 and 10. The data were used to develop a recommended response action, an HHRA, and site-specific recommendations concerning additional characterization. The IRI determined Site 9 was not releasing detectable levels of contamination to the underlying groundwater. The IRI also determined the absence of contamination in any downgradient wells and the similarity in chemical composition between upgradient and downgradient wells indicated that the landfill does not impact groundwater quality in this area. The IRI concluded that the overall trend at Site 10 is toward an improvement in groundwater quality, and that the Sewage Treatment Plant Landfill is having little or no measurable impact on shallow groundwater quality in the water table aquifer beneath it. The IRI recommended that no additional characterization or remediation were warranted for Sites 9 and 10 based on the results of the sampling during the RVS and IRI. A groundwater monitoring program was recommended to ensure that any post-closure releases of contamination were addressed as needed (Ebasco, 1991b).

Sites 9 and 10 were the subject of an RI/FS performed by FWES in 1993 (FWES, 1994b). The investigations included soil and groundwater sampling, and the RI/FS, including a baseline HHRA. The baseline HHRA concluded that there was no current risk posed by exposure to soil and groundwater at Site 9 and soil at Site 10; however, groundwater at Site 10 was a potential medium of concern. The RI/FS recommended long-term groundwater monitoring, and groundwater and land-use restrictions for Sites 9 and 10 to protect against any adverse risks to human health.

~~A Proposed Remedial Action Plan~~A PRAP and a DD for both Sites 9 and 10 prepared by Baker in January 1997 (Baker, 1997) called for long-term groundwater monitoring because of the contents of the landfill and its proximity to the Chesapeake Bay and other surface water bodies. The RI/FS, ~~Proposed Remedial Action Plan~~PRAP, and DD were conducted under the IRP before ~~JEB~~the former NAB Little Creek was placed on the NPL, and these aforementioned documents were not reviewed or accepted by USEPA or VDEQ.

An LTM program was prepared by FWES in 1996 (FWES, 1996a). Groundwater monitoring was proposed to be conducted semiannually for a period of 5 years for Target Compound List (TCL) VOCs, ~~semi-volatile~~semivolatile organic compounds (SVOCs), PCBs, total and filtered TAL metals, total cyanide, and anions including sulfate, bicarbonate, and chloride, during the first six rounds of sampling. Pesticides were added to the suite of monitored parameters for the seventh and eighth rounds. Following the first 3 years of monitoring, a 3-year summary report was completed (CH2M HILL, 2000a) recommending further sampling rounds be conducted on an annual basis because of the lack of seasonal variation and low-level contamination, and also recommending VOC analysis be discontinued because of the lack of contamination. Groundwater LTM continued on an annual basis with results presented in periodic letter reports submitted to the Navy, USEPA, and VDEQ following each round of sampling. The Draft Round 12 LTM Report submitted in December 2003 included recommendations to discontinue the analysis of SVOCs, pesticides, and PCBs in future post-ROD groundwater monitoring at the site based on infrequent low-level detections as shown in a statistical analysis of Rounds 1 through 12 analytical results.

To estimate the horizontal extent of the waste and to determine if there was adequate soil cover, a soil cover survey was conducted at Sites 9 and 10 by CH2M HILL in February 2000. Results confirmed the boundary of the landfills and demonstrated the majority of the landfills contain 2 or more feet of soil cover.

A SERA was completed for Sites 9 and 10 in June 2000 (CH2M HILL, 2000b) to determine if potential risks to ecological receptors warrant additional assessment and to identify potential data gaps. The SERA concluded that sufficient data were available for Sites 9 and 10 and recommended that these sites continue on to Step 3 of the

ERA process because one or more ~~chemicals~~constituents of potential concern (COPCs) and complete exposure pathways were identified at the sites.

A Revised RI/HHRA/FS was completed for Sites 9 and 10 in February 2001 (CH2M HILL, 2001c). The HHRA identified potential reasonable maximum exposure (RME) risks from the potable use of groundwater at the sites, based on antimony, cadmium, manganese, thallium, and zinc concentrations. To protect human and ecological receptors from exposure to landfill contents and to monitor for potential degradation of groundwater quality and offsite migration of groundwater contamination, the FS recommended LUCs and LTM at the sites.

A Baseline Ecological Risk Assessment through Step 3A ~~(BERA +3)~~ was conducted at Sites 9 and 10 in 2001 to determine if risks to ecological receptors from site-related chemicals were likely. NFA was recommended for the terrestrial habitats and for groundwater unless LTM indicated significant increases in constituent concentrations at Sites 9 and 10. Continuing to Step 3B was not warranted (CH2M HILL, 2001d).

The Proposed Plan for Site 9 and Site 10 was submitted for public review and comment during March 2001 for a 30-day period. A public meeting was held on March 28, 2001, to provide further information on the Proposed Plan for the ~~remedial actions~~RAs at the sites to the general public. The Proposed Plan consisted of three alternatives to address the contamination at the sites, as follows:

- NA
- LUCs with LTM
- Low-permeability cap with ~~institutional controls (ICs)~~ICs and LTM
- Five-year Review

The preferred alternative presented in the Proposed Plan was LUCs and LTM (CH2M HILL, 2001e). The selected remedy presented in the Final Sites 9 and 10 ROD was LUCs with LTM (CH2M HILL, 2003f). An LUC RD was completed in March 2004 (CH2M HILL, 2004d) to implement the RAOs outlined in the ROD and was followed by an ~~IRACR~~Interim Remedial Action Completion Report (IRACR) issued in February 2005 and signed in April 2005 to document completion of the RA and to document that the remedy is in place, operational, and functional in accordance with CERCLA (CH2M HILL, 2005c, 2005g).

Post-ROD Project Plans were developed in 2004 and consisted of annual groundwater LTM and quarterly landfill integrity inspections (CH2M HILL, 2004l). Analytical results and landfill inspections were summarized in LTM Reports submitted annually. The first two rounds of groundwater samples collected during LTM were analyzed for site-specific COCs, and the third round of LTM was analyzed for VOCs, SVOCs, pesticides, PCBs, and TAL total and dissolved metals. Groundwater samples from the round of LTM prior to the first Five-~~Year~~year Review were analyzed for site-specific COCs and supplemental parameters (TOC, total organic halogens [TOX], pH, and specific conductance) as agreed to by the Tier I Partnering Team in January 2007 (CH2M HILL, 2007e).

Sites 9 and 10 were included in the Five-year Review of sites with a remedy-in-place (CH2M HILL, ~~2009e~~2009d). The selected remedy for both sites was determined to be protective of human health and the environment. The Five-year Review recommended a revision to the LTM plan to select the analytical parameters and site specific monitoring wells for future sampling events. Additionally, the Five-year Review identified the need for corrective action to repair bare and the low-lying areas observed at both Sites 9 and 10. An O&M action was completed at Site 9 in September 2009, and included re-grading of the driving range, sprigging of vegetation, and installation of an irrigation system. The low-lying area at Site 10 was re-graded and sprigged in conjunction with the Site 9 O&M action (JV I, 2009). All maintenance actions were conducted with the approval of the JEB Little Creek Tier I Partnering Team and documented in the Final CCR in April 2010.

A Consensus Agreement was signed by the Tier I Partnering Team in May 2013, revising the finalized LUC RD for Sites 9 and 10. The revision reduced the required frequency of landfill inspection. The LUCs recorded in the LUC RD and the Consensus Agreements are part of the remedy and will be implemented, maintained, monitored, enforced, and reported on in accordance with the ROD and section 3.0 of the LUC RD and subsequent revisions.

The Navy submitted a revised draft LTM Exit Rationale technical memorandum in ~~February 2012~~November 2013 that ~~reviews~~reviewed existing groundwater data and ~~evaluates~~evaluated the need for continued groundwater

LTM at the sites (CH2M HILL, ~~2012b). The Navy submitted a draft RACR for Sites 9 and 10 in March 2012 (CH2M HILL, 2012e) and final signature of the document is scheduled for FY2013.~~2013k). LTM groundwater sampling has not been conducted since October 2007. Site inspections will continue throughout FY ~~2013~~2014.

Sites 9 and 10 were included in the second Five-year Review of sites with a remedy-in-place (CH2M HILL, 2014b). The selected remedies for both sites are in place, functioning as designed, and are currently protective of human health and the environment. However, in order to determine if the remedies are protective in the long-term, the Five-year Review recommended that a consensus among the Tier I Partnering Team be reached on Five-year Review data requirements and, as needed, a groundwater SAP be developed and implemented in conjunction with Five-year Reviews to demonstrate continued protectiveness of the remedies. An addendum to the second FYR to address long-term protectiveness at Sites 9 and 10 is scheduled for FY 2015. Additionally, the Five-year Review identified the need for corrective action at Site 10 to repair ruts in the soil cover and remove dispersed surface debris, including steel pipe, asphalt, and tires.

Commented [SMMCNME3]: Five-year Review?

The 5-year schedule for Sites 9 and 10 is provided on **Table 2-~~12~~10**. Planned activities at Sites 9 and 10 consist of the following:

- ~~LTM~~
- Five-Year Review Addendum
- Five-year Review

Site 11—School of Music Plating Shop

The School of Music Plating Shop was located in Building 3651. This building is located in the eastern portion of the base, near the intersection of 7th and E Streets (**Figure 2-~~7~~5**). The School of Music, located in Building 3602, is 10 feet southwest of the former plating shop. The site consisted of the plating shop building, an in-ground concrete tank used to neutralize plating solutions, and its associated piping. This site is also referred to as SWMU 27 (plating shop) and SWMU 28 (neutralization tank) in the RFA. Surrounding areas, apart from buildings and paved areas, are covered with grass and are generally level between manmade drainage ditches.

The neutralization tank for the plating shop had a diameter of 5 feet and a depth of 11 feet. Approximately 2.5 yd^3 of crushed limestone were placed in the bottom of the tank to neutralize the acidic plating bath wastes. Wastewater entered the tank via an acid-resistant drainpipe that originated in a sink in Building 3651. According to the IRI, neutralized wastewater was discharged from the unit into the storm sewer via an outlet and drain from the northwest side of the tank. All wastewater passed through limestone before it entered the discharge pipe connecting with the storm sewer.

The IAS reported that plating wastes were discharged into the neutralization tank during a 10-year period beginning in 1964. In 1974, the plating operations were transferred to a separate facility and discharges into the neutralization tank were discontinued. During its period of operation, the plating shop reportedly used silver cyanide, copper cyanide, chromic acid (brite dip), nickel plating baths, and various acids. In addition, lacquer strippers and lacquer were also used. Small quantities of these plating baths, acids, and lacquer strippers were disposed down the sink in the plating shop, which drained into the neutralization tank and eventually into the storm sewer system. The IAS reported that approximately 10 gallons of each plating chemical and lacquer stripper were disposed in the shop sinks each year.

As part of the 1986 RVS, three monitoring wells were installed at Site 11 (CH2M HILL, 1986). Subsurface soil samples were also collected to delineate the vertical extent of contamination in probable source areas. The results of the RVS sampling and analysis activities indicated that contamination was being released from Site 11, but the magnitude and distribution of this contamination could not be determined on the basis of the RVS findings alone. As part of the 1991 IRI, a second round of groundwater sampling was conducted (Ebasco, 1991b).

Site 11 was one of the six sites included in the RI/FS performed by FWES in 1993 (FWES, 1994b). Sampling efforts associated with the RI/FS included the collection of groundwater samples from the three monitoring wells installed during the 1986 RVS and 10 surface soil samples. The findings were summarized in the RI/FS report dated November 1994. The surface soil, the neutralization tank and its contents, and groundwater at Site 11 were

determined to be affected by contamination. Arsenic, beryllium, and manganese were detected above screening criteria in the surface soil, and TCE and 1,1-dichloroethene (DCE) were detected in the groundwater above MCL drinking water standards in one of the three monitoring wells at the site. The maximum concentrations of TCE and 1,1-DCE detected during the three rounds of groundwater sampling were 340 parts per billion (ppb) and 34 ppb, respectively.

A DD was issued by the Navy in November 1994, proposing the removal of the neutralization tank, associated piping, and the surrounding surface and subsurface soil (FWES, 1994a). The neutralization tank, piping, and surrounding soil were excavated in November 1995. An interim removal actionAn Interim Removal Action (IRA) Final Closeout Report was issued in May 1996 (ITC, 1996).

A short-term, post-removal groundwater monitoring program was proposed to verify the effectiveness of the source and contaminated-soil removal action (FWES, 1996a). Sampling results for Site 11 were scheduled to be assessed and the program reevaluated after 1 year (two rounds) of sampling. The first round of post-removal monitoring was conducted in May 1996 by FWES, and the second round of monitoring was completed by CH2M HILL in December 1996 (CH2M HILL, 1998b).

During post-removal groundwater monitoring, no metals were detected above MCLs or risk-based concentrations (RBCs,), indicating the removal action removed the source of metal contamination and the metal contamination. Historically, chlorinated hydrocarbons had only been detected in one monitoring well, LC11-GW01S, at Site 11. However, during the last round of the post-removal groundwater monitoring program, low levels of TCE were also detected in monitoring well LC11-GW03S at concentrations below the MCL for TCE. A decrease in the concentration of all chlorinated hydrocarbon groundwater contaminants was observed during the post-removal groundwater monitoring in monitoring well LC11-GW01S. Significant fluctuations in concentrations of contaminants had been historically observed in this monitoring well. Therefore, additional groundwater sampling was recommended to define the extent of the contamination in the groundwater and to evaluate if the contamination in monitoring well LC11-GW01S was on a permanent and irreversible downward trend.

SRI field activities at Site 11 were initiated in June 1998. As part of the SRI, additional DPT groundwater samples were collected to define the source area and extent of contamination at Site 11. Concentrations of chlorinated VOCs collected from 8 to 12 feet bgs in the shallow portion of the Columbia Aquifer did not exceed MCLs. Concentrations of 1,1-DCE, cis-1,2-DCE, and TCE exceeded MCLs in groundwater samples collected from the deep portion of the aquifer; generally from 17 to 21 feet bgs. Total chlorinated VOCs in the lower portion of the aquifer were found at greater concentrations and were more extensive than in the upper portion of the aquifer at Site 11. During this investigation, groundwater flow in the Columbia Aquifer at Site 11 was determined to be controlled both by the overall base-wide groundwater flow direction (east to west near Site 11) as well as by seepage into a system of sanitary sewer pipes that border the site on the east and south (CH2M HILL, 2004i). Groundwater flow in the deep Yorktown Aquifer is to the northwest.

As a result of the DPT groundwater sampling, 15 additional monitoring wells and two piezometers were installed. All of the new and existing monitoring wells were sampled in September 1998 and again in July 1999.

A Draft SRI Report for Site 11 was submitted for regulatory review in February 2001. This report summarized all new data obtained since the 1994 RI/FS. Data evaluation included surface and subsurface soil, and groundwater (DPT and monitoring well) samples. A qualitative HHRA was also conducted for the site as part of the SRI. Subsequent to the SRI, four subsurface soil samples were obtained at the site near the location of the former neutralization tank and its associated piping in February 2001, to provide additional data to be used in the amended HHRA. Because previous subsurface soil data (from the 1995 removal action) were not validated per CERCLA criteria, these newly obtained data were added to the SRI as an addendum.

The SRI concluded that the concentrations of inorganics (arsenic, lead, and iron) in surface soil exceeded both USEPA Region III RBCs and NABJEB Little Creek background concentrations in one or more samples. There were two chlorinated VOCs detected in groundwater that exceeded USEPA Region III tap water RBCs: 1,1-DCE and TCE. These compounds, along with 1,1,1-trichloroethane (TCA), also exceeded drinking water MCLs in at least one monitoring well. Groundwater contamination appeared to be limited to the lower portion of the water table

aquifer in the area immediately around the location of the former plating shop neutralization tank, extending south to Gator Boulevard. The area of greatest chlorinated VOC concentration was directly south and southeast of the former tank.

Recommendations made in the SRI Report included additional follow-up investigation activities, including a groundwater investigation north of monitoring well LS11-MW16D (which has subsequently been reclassified as AOC Site 11a) to determine if TCE contamination is associated with Site 11 or another source, and a groundwater investigation to delineate the area of elevated concentrations between the former location of the neutralization tank and monitoring wells LS11-MW05D and LS11-MW04D at the bottom of the aquifer to identify maximum concentrations, mass of contaminants, and, if feasible, the presence of dense non-aqueous phase liquid (DNAPL). Also, further investigation of the sanitary sewer line adjacent to the site was recommended.

A MIP investigation was conducted during the summer of 2001 to better identify the areas where DNAPL may be present in the vicinity of monitoring wells LS11-MW04D and LS11-MW05D and to quantify the extent of contamination in the northern portion of the site near monitoring well LS11-MW16D. Direct-push samples were collected to confirm the MIP results. The results indicated there had not been significant degradation of TCE (CH2M HILL, 2003e).

As a result of regulatory comments received on the Draft SRI, in September and October 2001, three monitoring wells were installed into the Yorktown Aquifer and sampled at Site 11 to determine if site contaminants had potentially entered the lower aquifer. The monitoring wells were sampled for TCL VOCs, TCL SVOCs, and dissolved major ions. Only chloroform exceeded applicable comparison criteria. A Draft Final SRI Report was completed in October 2002 and finalized in June 2004 documenting the sampling results (CH2M HILL, 2004i).

An Environmental Security Technology Certification Program (ESTCP) funded pilot test was conducted at Site 11 between June and October of 2002. The project was led by a consortium of four universities: University of Rhode Island, Colorado School of Mines, University of Texas at San Antonio, and University of Arizona. The goal of the pilot test was to evaluate the *in situ* removal of organic contaminants from groundwater through the injection and extraction of a cyclodextrin (CD) solution. The pilot study was completed during the summer of 2002 and concluded that the use of CD increased the rate of DNAPL removal relative to conventional water flooding (Boving et al., 2003). The resulting decrease in DNAPL saturation was approximately 81 percent. A follow-up groundwater sampling event was completed by CH2M HILL in January 2003 to evaluate organic compounds remaining in the groundwater at the site (CH2M HILL, 2003c). In addition, a MIP investigation at Site 11 was conducted in September 2003 to further assess the impact that the CD solution had on the groundwater at the site.

Additional investigation activities were completed in 2005 to assess remedial alternatives for consideration in the FS. In March 2005, two directional wells were installed and all site monitoring wells were sampled to provide a complete round of groundwater data. To investigate potential vapor intrusion of VOCs from groundwater into the School of Music (Building 3602), groundwater samples from the top of the water table aquifer and a water sample from the building's basement sump were collected in May 2005 for VOC analyses. Additionally, a building inspection and pressure testing was completed within Building 3602. Based on this effort, it was concluded Building 3606 was positively pressurized, reducing the potential for a driving force for vapor intrusion, and there were limited pathways for vapor intrusion into the building. Additionally, there were no VOCs detected in six of the eight shallow groundwater samples. Only chloromethane (1.7 µg/L) and TCE (6.3 µg/L) were detected, at very low concentrations. No VOCs were detected in the basement sump sample and VOC concentrations at the top of the water table were well below risk screening levels. The vapor intrusion assessment indicated that even if conditions promote vapor intrusion, concentrations of VOCs in groundwater would not represent unacceptable human health risks from vapor intrusion inside the School of Music building (CH2M HILL, 2006c).

~~Additional groundwater and soil sampling was completed in October 2005 to evaluate site characteristics associated with *in situ* remedial design technologies and to develop an SRI Addendum to update and re-evaluate potential human health risks associated with exposure to VOCs in groundwater (CH2M HILL, 2006b). An FS was developed for Site 11 to address VOCs in groundwater.~~ The remedial alternatives evaluated were no action and electrical resistance heating with ERD (CH2M HILL, 2006d). ~~The FS identified ERD accompanied by LUCs as the~~

~~preferred alternative, and a Proposed Plan was developed for public comment (CH2M HILL, 2006f). A ROD was submitted for legal review in November 2006 and was signed in July 2007 (CH2M HILL, 2007c).~~

An SRI Addendum was completed to reevaluate potential risk to human health based on the data collected from January 2003 through October 2005. The SRI addendum concluded potential human health risk was from exposure to VOCs and pentachlorophenol (PCP) in groundwater, and there is no unacceptable human health risk associated with exposure to inorganic constituents in groundwater and soil at Site 11 (CH2M HILL, 2006b). An additional round of groundwater sampling was completed in September 2006 to identify the extent of PCP in groundwater at Site 11. There were no detections of PCP in the three groundwater samples or corresponding quality control samples. Therefore, the Navy, in partnership with the USEPA and VDEQ determined that the 1999 detection of PCP in groundwater at Site 11 was likely a false positive, and based on the absence of PCP in the September 2006 groundwater samples, PCP is not considered a COC in groundwater at Site 11 (CH2M HILL, 2006g).

Additional groundwater and soil sampling was completed in October 2005 to evaluate site characteristics associated with *in situ* RD technologies and to develop an SRI Addendum to update and re-evaluate potential human health risks associated with exposure to VOCs in groundwater (CH2M HILL, 2006b). An FS was developed for Site 11 to address VOCs in groundwater. The remedial alternatives evaluated were (1) NA, (2) ERD, and (3) electrical resistance heating with ERD (CH2M HILL, 2006d). The FS identified ERD accompanied by LUCs as the preferred alternative, and a Proposed Plan was developed for public comment (CH2M HILL, 2006f). A ROD was signed in July 2007 (CH2M HILL, 2007c).

A sewer repair Work Plan was finalized in September 2007 (JVI, 2007d) with repairs to the leaking sanitary sewer line completed in late 2007. The final RA Work Plan was submitted in December 2008 (JVI, 2008d) and ~~remedial action~~RA began in January 2009 with the installation of five new monitoring wells, 26 injection wells, and baseline groundwater sampling. Injection of emulsified vegetable oil product was performed in April/May 2009 and an RA CCR was finalized in June 2010 (CH2M HILL, ~~2010b~~2010c). Performance monitoring was conducted at a frequency of 1-, 3-, 6-, 9-, and 12-months post-injection. A final ERD Summary Report was submitted in June 2011 outlining the initial result of the ERD approach (CH2M HILL, 2011e). Remediation was successfully implemented and has shown effectiveness in achieving geochemical conditions to facilitate ERD. Concentrations of COCs had decreased, but remained above MCLs; therefore, the Summary Report recommended moving forward with the development of the groundwater LTM plan and concluded no additional injections were required at this time.

Site 11 was included in the Five-year Review of sites with an RIP (CH2M, ~~2009e~~2009d). At the time the report was finalized, the remedy had not been implemented, but was expected to be protective of human health and environment. Further evaluation of the vapor intrusion pathway was recommended following resolution of the risk evaluation methodology.

The LUC RD for Site 11 was finalized in March 2009 (CH2M, ~~2009f~~2009e). A Consensus Agreement was signed by the Tier I Partnering Team in May 2010, revising the finalized LUC RD for Site 11. A second Consensus Agreement ~~is scheduled to be~~was signed by the Tier I Partnering Team in ~~FY~~May 2013. The revisions more clearly identify the risks and receptors the LUCs were intended to address. The LUCs recorded in the LUC RD and the Consensus ~~Agreement~~Agreements are part of the remedy and will be implemented, maintained, monitored, enforced, and reported on in accordance with the ROD and sections 3.0 and 4.0 of the LUC RD~~.~~ and subsequent revisions. LUCs will be maintained within the LUC boundary at Site 11 until concentrations of VOCs in groundwater are reduced to levels that allow unlimited use and unrestricted exposure. The Final IRACR was signed in February 2012 (CH2M HILL, ~~2012c~~2012b). The LTM SAP, including groundwater and VI sampling, was finalized in March 2012 (CH2M HILL, ~~2012d~~2012c) and biannual LTM began in March 2012. ~~Results will be provided in a~~A draft LTM Report ~~following completion~~, which provides the results of the first four monitoring events~~.~~, was submitted for regulatory review in April 2014 (CH2M HILL, 2014d).

Site 11 was included in the second Five-year Review of sites with a remedy-in-place (CH2M HILL, 2014b). The Five-year Review determined that the selected remedy is in place, functioning as designed, and is currently protective of human health and the environment. However, in order to evaluate long-term protectiveness of the remedy,

the Five-year Review recommended a groundwater evaluation be completed to determine the presence or absence of 1,4-dioxane in groundwater. An addendum to the Five-year Review to address long-term protectiveness is scheduled for FY 2015.

The 5-year schedule for Site 11 is presented in **Table 2-~~13~~11**. Planned activities at Site 11 consist of:

- LTM
- Five-Year Review Addendum
- Five-year Review

Site 11a—Building 3033 Former Waste Oil Tank

Site 11a, located north of Site 11 (**Figure 2-6)**, was identified during the 1998 SRI at Site 11 when the VOC TCE was detected in the upgradient monitoring well LS11-MW16D at a concentration of 100 µg/L (CH2M HILL, 2004i). Groundwater samples were collected using DPT in 2001 and sample results confirmed the presence of elevated TCE concentrations in this area. Based on these results, the area north of Site 11 was identified as AOC Site 11a. Two former buildings, Buildings 3033 and 3034, had been located at the site. No documented releases were associated with former Building 3034, which was located in the grass-covered field and was used as a garden supply center. Historical records indicated the presence of a former underground waste oil tank associated with Building 3033, a 12-bay vehicle repair facility located immediately south of the current barracks building. The tank was reportedly excavated and removed in 1988 under the Underground Storage Tank (UST) Program; however, documentation of tank closure is not available. The tank was identified as SWMU 60 in the FFA and SWMU/IR Summary Report and was closed out with NA following a desktop audit prior to JEB Little Creek's placement on the NPL. The contents of the tank were not documented in these reports. However, groundwater analytical data and MIP results indicated high VOC concentrations in the shallow portion of the aquifer near the area of the former waste oil tank.

A soil and groundwater investigation was conducted as part of an SI in July 2002 and included field screening for TCE coupled with soil and groundwater sampling to confirm the field screening results, monitoring well installation, and groundwater sampling (CH2M HILL, 2003d). The investigation results confirmed the presence of a TCE plume in groundwater with higher concentrations at the bottom of the Columbia Aquifer. TCE concentrations in soil did not exceed regulatory risk-based screening criteria.

A MIP investigation was conducted in September 2003 to delineate the chlorinated VOC plume (CH2M HILL, 2003e). During the MIP investigation, a potential source area of elevated tetrachloroethene (PCE) concentrations in the unsaturated zone was identified. Subsequent groundwater samples were collected to confirm MIP results. Monitoring wells were installed and sampled using passive diffusion bags in February 2004 at various depths within the Columbia Aquifer to determine both the horizontal and vertical stratification of the chlorinated VOC plume (CH2M HILL, 2004e). Results of the MIP investigation and groundwater sampling activities were used to develop a Treatability Study (TS) Work Plan consisting of *in situ* chemical oxidation (ISCO) and post-injection groundwater monitoring (CH2M HILL, 2005a). Implementation of the TS for ISCO was completed in March 2005 and was followed by sampling of the groundwater in April 2005, July 2005, and November 2005. Groundwater monitoring data provided in the TS Report indicated mixed results on the effectiveness of ISCO in reducing VOC concentrations (CH2M HILL, 2006e). Incomplete distribution of reagent in the aquifer likely contributed to the lack of significant VOC reduction across the site. The Tier I Partnering Team agreed that an RI was warranted for the site.

Soil and groundwater samples were collected and analyzed as part of the RI, conducted in September/October 2007, to assess the nature and extent of contamination at the site and quantify potential human health and ecological risks. The RI report was finalized in July 2010 (CH2M HILL, 2010d). The RI recommended further evaluation of possible vapor intrusion into Building 3606 and recommended additional confirmation of contaminants in one monitoring well (LS11A-MW20D). The RI further recommended that an FS be conducted to develop RAOs and evaluate remedial alternatives to mitigate the potentially unacceptable site-related risks posed by the COCs in groundwater. The RI concluded that NFA is warranted for soil associated with Site 11a.

In response to RI recommendations, an RI Addendum was completed to assess the potential for vapor intrusion in Building 3606 (CH2M HILL, 2011c). Results from the sub-slab soil vapor samples collected in November 2009 exceeded screening criteria. Subsequent sub-slab vapor and indoor air samples were collected in Building 3606 and adjacent Building 3606a in March 2010. Similar to the November 2009 analytical results, the analytical results from the sub-slab vapor samples and indoor air samples collected in March 2010 exceeded screening criteria. A screening level HHRA concluded concentrations of VOCs did not pose unacceptable risk associated with vapor intrusion in existing buildings under current site conditions; however, future degradation of existing building conditions may increase the potential for risk. LTM of the vapor intrusion pathway as part of the shallow groundwater remedy was recommended.

Due to a detection of PCP in a groundwater sample from monitoring well LS11A-MW20D during the RI sampling event in 2007 (previously collected groundwater samples from this monitoring well were not analyzed for PCP), a confirmation round of groundwater samples was collected from all Site 11a monitoring wells in September 2009. PCP was not detected in any of the groundwater samples collected during the September 2009 sampling event. Based on results of the groundwater samples, it was determined there was no PCP groundwater plume and PCP should not be considered a COC.

A final FS was submitted in June 2011 (CH2M HILL, 2011d) and the Proposed Plan was finalized in August 2011 (CH2M HILL, 2011f) and recommended ERD, LUCs, and LTM as the preferred remedial alternative for Site 11a. The ROD was signed in September 2011 (CH2M HILL, 2011g). A 90 Percent Basis of Design (CH2M HILL, 2011h) and RA Work Plan UFP SAP (Osage, 2012a) were submitted in August 2011, and RA began in March 2012 with the installation of 5 new monitoring wells and baseline groundwater sampling. Based on the results of the baseline groundwater sampling, a 100 Percent Basis of Design (CH2M HILL, 2012h) and Revised Final RA Work Plan UFP SAP (Osage, 2012b) were submitted in October 2012. Injection of emulsified vegetable oil was performed in November 2012 and an RA CCR was finalized in June 2013 (Osage, 2013). Performance monitoring was completed at a frequency of 1-, 3-, 6-, 9-, and 12-months post-injection, with the final round conducted in May 2013. A final Remedy Effectiveness Evaluation was submitted in May 2014 outlining the initial results of the ERD approach (Osage, 2014). Remediation was successfully implemented and has shown effectiveness in achieving geochemical conditions to facilitate ERD. Concentrations of COCs remained above MCLs; therefore, the development of the groundwater LTM plan was recommended.

The LUC RD was finalized in April 2013 (Navy, 2013). A Consensus Agreement was signed in May 2013 by the Tier I Partnering Team to address changes in LUC objectives language between the ROD and final LUC RD. The LUCs recorded in the LUC RD are part of the remedy and will be implemented, maintained, enforced, and reported on in accordance with the ROD and Sections 3.0 and 4.0 of the LUC RD. LUCs will be maintained within the LUC boundary at Site 11a until concentrations of VOCs in groundwater are reduced to levels that allow unlimited use and unrestricted exposure. The Final IRACR was signed in September 2013 (CH2M HILL, 2013i). The draft LTM SAP, including groundwater and VI sampling, was submitted for regulatory review in February 2014 (CH2M HILL, 2014a) and biannual LTM is scheduled to begin in September 2014. Results will be provided in an LTM Report following completion of the first four monitoring events.

Site 11a was included in the second Five-year Review of sites with a remedy-in-place (CH2M HILL, 2014b). The Five-year Review determined that the selected remedy is in place, functioning as designed, and is protective of human health and the environment.

The 5-year schedule for Site 11a is presented in **Table 2-12**. Planned activities at Site 11a consist of the following:

- LTM
- Five-year Review

Site 12—Exchange Laundry Waste Disposal Area

The Exchange Laundry/Dry Cleaning Facility, referred to as SWMU 77 in the RFA, was located in Former Building 3323, near the intersection of Former 3rd (Amphibious Drive) and B Streets, in the eastern portion of JEB Little Creek (**Figure 2-87**). Building 3323 was demolished in 1987 for the construction of the existing commissary (Building 3445).

As reported in the IAS, wastes were dumped into the stormwater line and were thought to flow into the drainage canal via an outfall located immediately west of the former laundry building. However, review of the stormwater configuration, conducted by Little Creek personnel in the summer of 1991, revealed that drainage from the catch basin reportedly used for the dumping actually flows north along B Street and then west along the north side of Building 3329, before flowing into the canal. Based on this information, the outfall for wastes dumped into the catch basin was approximately 350 feet north of the outfall sampled during the IRI investigation and the 1986 RVS. Drainage into the outfall pipe sampled during the IRI comes from a relatively small area of the parking lot around Building 3432. Based on recommendations made in the Site Characterization Report (SCR) for the commissary construction project (FWES, 1992), the stormwater line was removed during the construction of the new building and the area was regraded.

The ground surface at the site was mostly an asphalt-paved parking area associated with the car wash and former Buildings 3432, 3433, 3434, and 3435 (all replaced by Building 3445). The former Building 3323 parking lot was graded to create the parking area for the new commissary building in 1993. The outfall immediately west of the car wash consists of a 12-inch galvanized iron pipe located approximately 3 feet bgs. This outfall is referred to as the "southern" outfall or discharge pipe. The outfall located north of Building 3445, the "northern" outfall, which is connected to the catch basin used for disposal, was not inspected during the IRI field program, but probably had a configuration similar to the southern outfall. The catch basin used for disposal, located southwest of the former intersection of 4th and B Streets, has since been removed.

The drainage canal, which borders the site to the west, is approximately 20 feet wide and 9 feet deep from the top of the bank. The sides of the canal are steep and covered with a relatively thick growth of vegetation. At the time of the April 1991 IRI site visit, the canal contained approximately 2 to 3 feet of water (that is to say, the water level was 6 to 7 feet below the top of the bank). The canal is bordered by a 20- to 30-foot-wide strip of vegetation on either side containing abundant trees, bushes, and weeds. The flow direction in the canal is to the south and is controlled by a weir at Little Creek Cove that prevents the tides in the cove from backing up into Lake Bradford (Ebasco, 1991b).

The IAS reported that wastes dumped into the stormwater line included PCE sludges, soap, sizing, and dyes. The period of operation and disposal lasted from 1973 until 1978, during which an estimated 1,320 gallons of waste were dumped into the stormwater drain. Of this total, approximately 200 gallons were PCE sludges. In addition to the dumping, smaller quantities of PCE and other wastes may have entered the stormwater line through runoff from spills or overflow of waste containers (RGH, 1984).

As part of the RVS, six surface water and six shallow sediment samples were collected at Site 12 to verify the presence or absence of contamination as recommended in the IAS. Contamination was detected in one or more media at Site 12 and recommendations were made to continue investigating the site to confirm RVS activities.

ATEC Environmental completed a two-phase environmental assessment of Site 12. The Phase I analysis, conducted in 1990, included monitoring well installation, groundwater sampling, soil sampling, and sediment sampling (ATEC, 1990). The second phase of the ATEC assessment was conducted in 1991 to verify the Phase I findings and provide a more detailed delineation of the extent of groundwater contamination at Site 12 (ATEC, 1991). The specific activities completed for Phase II included the drilling, installation, and sampling of two additional monitoring wells, collection of a second round of samples from the eight existing wells, and the establishment of vertical well elevation data to determine the direction of groundwater flow. Following the Phase II action, an SCR was completed in June 1992.

The Site 12 RI/FS (FWES, 1994b) included monitoring well installation, and groundwater, surface water, and sediment sampling. Groundwater samples were collected from the four monitoring wells and were analyzed for VOCs. Total 1,2-DCE, TCE, and PCE were among the VOCs detected in groundwater samples. Four surface water samples and four sediment samples were collected from the canal adjacent to Site 12. These samples were analyzed for VOCs and TAL metals. Chlorinated solvents and metals were detected in the canal surface water and sediment samples. Based on the findings, the RI/FS recommended additional subsurface soil, groundwater, and surface water sampling at the site, as well as additional hydrologic testing.

Three monitoring wells were installed in the Yorktown Aquifer below the Yorktown Confining Unit to monitor the presence of select VOCs in the Yorktown Aquifer; no VOCs were detected. Groundwater flow in the Yorktown Aquifer is north, toward the Chesapeake Bay (CH2M HILL, 2000c).

Groundwater sampling for natural attenuation parameters as well as for chlorinated VOCs was conducted in July and September of 1998. The purpose of this sampling was to determine the extent of contamination and if biodegradation was occurring at a rate that would make it a viable remedial alternative. Based on the reduction in concentrations of chlorinated VOCs over time and the presence of PCE breakdown products (TCE and cis-1,2-DCE) in the groundwater collected from selected wells, biodegradation was determined to be occurring at the site. FWES (Phase I) (FWES, 1996b) and CH2M HILL (Phase II) (CH2M HILL, 2000c) completed the SRI for Site 12. The documents noted groundwater flow in the Columbia Aquifer was to the west and was intercepted by a leaking sanitary sewer manhole and pipe located below the water table, which created a localized sink that impacted groundwater flow throughout the entire site. A surface water drainage canal borders the site to the west of the sewer. Surface water in the canal appeared to infiltrate the groundwater and flow east toward the sewer. A weir artificially controls the water level in the canal.

A MIP investigation was conducted at Site 12 during the summer of 2001 to better identify the location of the source plume. The study revealed that there were two PCE plumes at Site 12. The concentrations of PCE appeared to be decreasing over time based on a comparison against data from previous sampling events. The decrease in concentrations was attributed to dilution and a biological breakdown to TCE.

The Final FS was submitted in March 2004 and recommended biostimulation and pump and treat with biostimulation. In September 2004, an FS Addendum was submitted as part of the revised final FS to include ISCO as an additional treatment alternative for groundwater contamination at the site (CH2M HILL, 2004k). ISCO followed by ERD was determined to be the preferred alternative. The Proposed Plan was finalized in June 2005 (CH2M HILL, 2005h) and the ROD was signed in September 2005 (CH2M HILL, 2005l). The RA Work Plan was distributed for regulatory review in March 2006. In April 2006, it was determined that—given the likelihood for increased metals concentrations in groundwater as a result of ISCO (permanganate) implementation—the remedy would be ERD and monitoring. The remedy modification was documented in an Explanation of Significant Difference signed in October 2006 (CH2M HILL, 2006h).

The RA Work Plan for implementation of ERD using EOS® at Site 12 was finalized in February 2007 (JV I, 2007a). RA construction was completed from March to April of 2007 and included EOS® injection and groundwater sampling. Because the baseline sampling results from May 2005 indicated potential movement of contaminants to the west following repair of the stormwater sewer, additional groundwater sampling was conducted to verify the western and southwestern plume boundary. Sampling results indicated that the southwestern plume boundary was adequately defined. However, to monitor for contaminant migration towards the drainage canal, installation of one additional well pair (one shallow and one deep well) outside of the western boundary, was recommended. The Addendum to the RA Work Plan was completed to document the results and the conclusions from the sampling event, and the two additional monitoring wells were installed in October 2007 (JV I, 2007c).

An RA CCR was finalized in October 2008 and outlined the RA construction activities (JV I, 2008c). Post-injection monitoring occurred at 1-, 3-, 6-, 9-, and 12-month intervals. A draft final ERD Summary Report was submitted in October 2008 outlining the initial result of the ERD approach. Remediation was successfully implemented and had shown effectiveness in achieving geochemical conditions to facilitate ERD. Concentrations of COCs had decreased, but remained above MCLs; therefore, an additional substrate injection was recommended to keep aquifer conditions amenable for reductive dechlorination to continue. A second injection was completed in March 2009 and one groundwater sampling event was conducted in June 2009. ~~Groundwater sampling results will be presented in a subsequent report documenting LTM results.~~ The Final IRACR was signed in May 2010 (CH2M HILL, ~~2010a~~2010b).

Site 12 was included in the Five-year Review of sites with a remedy in place (CH2M, ~~2009e~~2009d). At the time that the report was finalized, the remedy had been implemented, was functioning as designed, and was expected to be protective of human health and environment. Continued monitoring of plume configuration and migration

will be conducted through post-remedial action groundwater monitoring to ensure long-term effectiveness of the remedy.

The LUC RD for Site 12 was finalized in February 2009 (CH2M, 2009c). A Consensus Agreement was signed by the Tier I Partnering Team in May 2011, revising the finalized LUC RD for Site 12. A second Consensus Agreement ~~is scheduled to be~~was signed by the Tier I Partnering Team in ~~FY~~May 2013. The revisions more clearly identify the risks and receptors the LUCs were intended to address. The LUCs recorded in the LUC RD and the Consensus Agreement are part of the remedy and will be implemented, maintained, monitored, enforced, and reported on in accordance with the ROD and sections 3.0 and 4.0 of the LUC RD~~.~~ and subsequent revisions. LUCs will be maintained within the LUC boundary at Site 12 until concentrations of VOCs in groundwater are reduced to levels that allow unlimited use exposure and unrestricted exposure. The groundwater LTM SAP was finalized in January 2011 (CH2M~~-~~ HILL, 2011a) and biannual groundwater LTM began in March 2011. ~~Results will be provided in a~~A draft LTM Report ~~following~~, which provides the ~~completion~~results of ~~two years of LTM.~~the first six monitoring events, was submitted for regulatory review in April 2014 (CH2M HILL, 2014d).

Site 12 was included in the second Five-year Review of sites with a remedy-in-place (CH2M HILL, 2014b). The Five-year Review determined that the selected remedy is in place, functioning as designed, and is protective of human health and the environment. The Five-year Review recommended revising the existing surface water project action levels to account for potential ecological exposures at the groundwater/surface water interface within the drainage canal.

The 5-year schedule for Site 12 is provided on **Table 2-~~14~~13**. Planned activities at Site 12 consist of the following:

- LTM
- Five-year Review

Site 13—Public Works Pentachlorophenol Dip Tank and Wash Rack

The PCP Dip Tank and Wash Rack is located near the intersection of 7th and F Streets in the eastern portion of JEB Little Creek, approximately one block west of Site 11 (**Figure 2-~~9~~8**). The site consisted of a former dip tank that was used to treat wood with a mixture of PCP, diesel, and kerosene; an adjacent area that contained drying racks for the PCP-treated wood; an open area formerly used by the Public Works Center (PWC) for storage of supplies and equipment; and a concrete wash rack at the southwestern end of that area. This site is also referred to in the RFA as SWMUs 14 (wash rack) and 15 (dip tank).

The PCP dip tank was located in the southwest corner of the fenced compound west of Building 3165E. The tank was in operation from the early 1960s until 1974. According to a former PWC supervisor, the tank was constructed of metal and was 20 feet in length and 5 feet in diameter. The top third of the tank was cut off and replaced with a metal lid. The bottom half of the tank was buried in the ground. A tank of this size and these specifications would hold approximately 1,500 gallons.

The tank contained a mixture of one part PCP to ten parts diesel and kerosene. Wood was dipped into the tank and either set on racks for drying or placed directly on trucks for delivery to where it was to be used on base. The drying racks were located immediately east of the dip tank between the tank and Building 3165E. A pump was located at the south end of the tank, outside the fenced compound. This pump was used to keep the contents of the tank mixed and to empty the contents of the tank into 55-gallon drums when it became spent. According to the former PWC supervisor, there had only been one PCP tank throughout the history of this area and it was always in this location. The dip tank was cleaned out approximately every 6 months, at which time the approximately 55 gallons of PCP sludge is believed to have been disposed in the Amphibious Base Landfill (Site 7) (RGH, 1984). All remaining PCP solution and associated sludges were removed from the tank in 1975. The tank itself was dismantled in 1982. The area formerly containing the PCP dip tank and drying racks has since been paved with asphalt and converted to a PWC storage area.

The wash rack and associated storage area, both of which were immediately south of the dip tank and west of Building 3165D, continue to be used by the PWC. The wash rack, located at the southwestern corner of the storage area, is a concrete pad with bermed sides and centrally located deck drain. The rack was installed in 1945

and is used by the PWC to clean vehicles, equipment, and miscellaneous objects with steam and biodegradable chemical cleaners. Wash water and other runoff from the rack drains through the central deck drain into an oil-water separator (OWS) located under the paved driveway between the wash rack and Building 3165. The OWS is accessible via a rectangular steel manhole located in the driveway. The contents of the separator, as observed in April 1991, included both oily sludge and oil. The oily discharge from the OWS is removed and taken to Craney Island Fuel Facility, and the water is routed to the sanitary sewers.

The unpaved storage area immediately north of the wash rack, between the wash rack and the former location of the PCP dip tank, was used for the storage of various materials and equipment. The IAS reported readily observable solvents, paint, fuel, and tar staining the surface in this area. During the IRI, the gravel area was free of surface staining, indicating that although the area continued to be used as a storage yard by the PWC, the occurrence of spillage and other releases has been significantly reduced (Ebasco, 1991b).

As part of the RVS, five groundwater monitoring wells were installed at Site 13 to facilitate the collection of groundwater samples and hydraulic head data to determine groundwater flow directions. Three surface soil and three subsurface soil samples were collected to help define the nature of contamination in probable source areas. A second round of groundwater monitoring was conducted during the IRI.

Site 13 was included in the RI/FS performed by FWES in 1993 (FWES, 1994b). Groundwater, surface soil, and subsurface soil samples were collected and analyzed during this investigation. The highest total VOCs detected in surface soil was 19 ppb, and the total SVOCs detected ranged from 1,210 ppb to 95,800 ppb. VOC concentrations in the subsurface soil were as high as 250 ppb, while SVOCs (primarily PCP) were detected in subsurface soil at concentrations ranging from 11,000 ppb to 890,000 ppb. The maximum total VOCs concentration detected in groundwater was 262 ppb. Vinyl chloride was detected in groundwater at 200 ppb. SVOCs were detected at four of the six groundwater sampling locations. PCP was detected at three of the six groundwater sampling locations; the highest concentration detected was 1,700 ppb near the former dip tank.

Additional site data were obtained during the Phase I SRI (FWES, 1996b). VOCs were detected in 10 of the 12 groundwater samples collected from monitoring wells at the site. The highest concentration of a VOC was PCE at 1,200 ppb. Several SVOCs were detected in groundwater samples. PCP was detected at the greatest concentrations, with a maximum concentration of 2,300 ppb observed near the former dip tank.

Additional soil and groundwater sampling was conducted, as part of a Phase II SRI, to fully delineate the contamination in these media. Results of this portion of the Phase II SRI are reported in the EE/CA for Site 13 (CH2M HILL, 1999a). The EE/CA was prepared to address the PCP soil contamination in the area of the former dip tank. The EE/CA recommended excavation of approximately 150 yd^3 of soil. The soil was removed during an IRA completed in the spring of 1999 and recorded in a Closeout Report (OHM, 1999b). The Final SRI was submitted in May 2002 (CH2M HILL, 2002a).

Groundwater flow was historically influenced by seepage into a system of sanitary sewer pipes that border the site on the west. However, based on a sanitary sewer evaluation conducted in 2004, it was determined a portion of the sewer system had been abandoned and the sewer system only minimally impacted groundwater flow (CH2M HILL, 2004n). Flow direction at the site has been observed to flow west to southwest.

In March 2000, an Oxygen Releasing Compound® (ORC) Pilot Study was performed at the site to test the compound's effectiveness in reducing PCP concentrations in groundwater. Six rounds of post-injection monitoring were conducted for a period of 60 weeks (through January 2002). Results indicated a significant decrease in PCP concentrations over the duration of the pilot study (CH2M HILL, 2003a).

A Site 13 FS, finalized in June 2004, evaluated options to address VOCs and PCP contaminants in groundwater (CH2M HILL, 2004h). The FS indicated that enhanced anaerobic bioremediation and enhanced aerobic bioremediation rank relatively higher than the other alternatives for short-term effectiveness. A TS using chemical oxidation in one portion of the site and anaerobic bioremediation in another portion of the site began in November 2004 (CH2M HILL, 2004o). Six rounds of post-injection monitoring were completed in 2005, and the results were documented in the TS Report (JV I, 2006). Results indicated that both chemical oxidation and

anaerobic bioremediation were effective in reducing concentrations; however, further treatment was necessary because the remediation goals (MCLs) were not met. The TS concluded that anaerobic bioremediation was the most favorable alternative for continued treatment of site COCs. In addition, because the groundwater plume extends beneath Building 3165, a vapor intrusion assessment was warranted prior to development of the Proposed Plan and ROD.

To investigate potential vapor intrusion of VOCs from groundwater into Buildings 3165, 3165B, 3165D, 3165E, and Former Building 3660, groundwater samples from the top of the water table aquifer were collected in September–October 2006 for VOC analysis. Additionally, building inspections and pressure testing was completed. Based on this effort, it was concluded there is only limited potential for vapor intrusion to Building 3165; however the occupied portion of the building is neutral to positively pressurized, reducing the potential for a driving force for vapor intrusion. VOCs were detected in three of five shallow groundwater samples; however concentrations were below risk screening levels. The vapor intrusion assessment indicated that even if conditions promote vapor intrusion, concentrations of VOCs in groundwater would not represent unacceptable human health risks from vapor intrusion inside Building 3165 (CH2M HILL, 2007a).

Anaerobic bioremediation (that is to say, ERD) was determined to be the preferred alternative; the Proposed Plan was finalized in June 2007 (CH2M HILL, 2007b) and the ROD was signed in September 2007 (CH2M HILL, 2007f).

The ~~draft~~ final RA Work Plan for implementation of ERD at Site 13 was submitted in March ~~2009~~2010 (CH2M HILL, ~~2009d). The RA Work Plan was finalized in March 2010,~~2010a), and ~~remedial action~~RA began that same month with the installation of five new monitoring wells and 27 injection wells. Injection of emulsified vegetable oil product was performed in May 2010 and an RA CCR was completed in April 2011 (JV III, 2011a). Performance monitoring was conducted at a frequency of 1-, 3-, 6-, 9-, and 12-months post-injection. A ~~draft~~final ERD Summary Report was submitted in ~~May~~September 2011 outlining the results of the 1-, 3-, and 6-month sampling events (JV III, ~~2011a~~2011b). Remediation was successfully implemented and had shown effectiveness in achieving geochemical conditions to facilitate ERD. Concentrations of COCs had decreased, but remained above MCLs; therefore, the Summary Report recommended moving forward with the development of the groundwater LTM Plan and concluded no additional injections were required at this time.

Site 13 was included in the first Five-year Review of sites with ~~an RIP~~a remedy-in-place (CH2M, ~~2009e~~2009d). At the time the report was finalized, the remedy had not been implemented, but was expected to be protective of human health and environment. Further evaluation of the vapor intrusion pathway was recommended following resolution of the risk evaluation methodology.

The LUC RD for Site 13 was finalized in March 2009 (CH2M, ~~2009g~~2009f). A Consensus Agreement was signed by the Tier I Partnering Team in May 2010, revising the finalized LUC RD for Site 13. A second Consensus Agreement ~~is scheduled to be~~was signed by the Tier I Partnering Team in ~~FY~~May 2013. The revisions more clearly identify the risks and receptors the LUCs were intended to address. The LUCs recorded in the LUC RD and the Consensus Agreement are part of the remedy and will be implemented, maintained, monitored, enforced, and reported on in accordance with the ROD and Sections 3.0 and 4.0 of the LUC RD and subsequent revisions. LUCs will be maintained within the LUC boundary at Site 13 until concentrations of PCP and VOCs in groundwater are reduced to levels that allow unlimited use and unlimited exposure. The final IRACR was signed in November 2012 (CH2M HILL, ~~2012i). The groundwater LTM SAP was finalized in June 2012 (CH2M HILL, 2012g) and biannual groundwater LTM began in September 2012. Results will be provided in an LTM Report following the completion of one year of LTM.~~2012g).

The LTM SAP was finalized in June 2012 (CH2M HILL, 2012e) and biannual groundwater LTM began in September 2012. In response to the recommendation made in the first Five-year Review, evaluation of potential risks associated with vapor intrusion was incorporated into the Site 13 LTM program. Because those buildings located within 100 feet of the Site 13 plume either do not present complete exposure pathways or are currently sampled as part of Site 11 vapor intrusion LTM, sampling specifically associated with Site 13 is not currently conducted. If building uses/conditions change or buildings are dropped from the Site 11 LTM program, vapor intrusion monitoring as part of Site 13 LTM will be initiated. Baseline VI LTM was completed at Site 11 in May and

December 2012. No potential risks were identified. A draft LTM Report, which provides the results of the first three monitoring events, was submitted for regulatory review in April 2014 (CH2M HILL, 2014d).

Site 13 was included in the second Five-year Review of sites with a remedy-in-place (CH2M HILL, 2014b). The selected remedy is in place, functioning as designed, and is protective of human health and the environment.

The 5-year schedule for Site 13 is presented in **Table 2-1514**. Planned activities at Site 13 consist of the following:

- LTM
- Five-year Review

2.4.42.4.3 Response Complete Sites

Response Complete—Site Screening and Investigation Process

One hundred and four sites warranted NA following desktop audits by the Navy, USEPA, and VDEQ (**Table 2-1**). In addition, following the SIs, 20 sites were closed with NFA. Currently, there are no sites or AOCs proposed for a screening assessment. If a potential CERCLA release is discovered, documentation will be provided in subsequent SMP updates. The locations of the NA and NFA sites are shown on **Figure 2-109** and a brief discussion of the SI NFA sites is provided below.

During FY 2002, a closeout report was prepared for Sites 5, 15, and 16 and SWMU 2 (CH2M HILL, 2002c). The analytical results from samples collected at Site 5 and SWMU 2 indicated concentrations below human health screening criteria and low-to-negligible ecological risk because of the lack of direct exposure pathways. Removal actions were conducted at Sites 15 and 16 in 1995 that consisted of excavation and disposal of PCB-contaminated soil, vegetation, and a utility pole at Site 16. Additional sampling indicated that Sites 15 and 16 were not expected to pose unacceptable risks to human health and the environment. Based on the findings, the JEB Little Creek Tier- I Partnering Team determined that NFA was required at these sites. Land use at these sites is unrestricted.

In June 2003, the Navy, USEPA, and VDEQ agreed to close out SWMU 30 with NFA and inform the Navy program staff managing USTs and aboveground storage tanks (ASTs) of their responsibility for any future “needed” action. Any further assessment or remediation will be covered under the Spill Prevention, Control, and Countermeasures (SPCC) Plan/UST Program.

AOCs H, I, and J, and Site 14 were evaluated in August 2003, and the analytical results from samples collected indicated no human health or ecological risk at any of the sites. Based on the findings, the Navy, USEPA, and VDEQ determined that NFA was appropriate for these sites, and the Final Closeout Report was signed in March 2004 (CH2M HILL, 2004c). Land use at these sites is unrestricted.

SWMUs 96, 97, 98, and 119 were evaluated in June 2004. Desktop audits as well as site visits showed no additional sampling was required to close out these sites. The analytical results from samples collected at SWMU- 119 indicated no human health or ecological risk at this site. Based on the findings, the Navy, USEPA, and VDEQ determined that NFA was appropriate for these sites, and the Final Closeout Report was signed in September 2004 (CH2M HILL, 2004j). Land use at these sites is unrestricted.

SWMUs 5, 6, 13, 18, and 116, Site 6, and AOC D were evaluated in FY 2005. Desktop audits showed no additional sampling was required for SWMUs 18 and 116, and AOC D. The analytical results from samples collected at SWMUs 5, 6, and 13, and Site 6 indicated no human health or ecological risks at the site. Based on the findings, the Navy, USEPA, and VDEQ agreed that NFA was appropriate for SWMUs 5, 6, and 13, and Site 6 sites; the Final Site Screening Assessment Closeout Report was signed in January 2006 (CH2M HILL, 2006a). Land use at SWMUs- 5, 6, 13, 18, and 116, Site 6, and AOC D sites is unrestricted.

Response Complete—Record of Decision

Following a quantitative assessment of human health and ecological risks, RODs have been signed for Site~~s~~ 8 and SWMUs 7a, 7b, and 8 that require NFA (**Figure 2-109**).

Site descriptions for Site~~s~~ 8 and ~~SWMU~~ SWMUs 7a, 7b, and 8 are provided below. ~~Although SWMU 7a has been closed with NFA, SWMU 7b activities are ongoing in the CERCLA process, and the site details are provided in Section 2.4.1 of this report.~~

Site 8—Demolition Debris Landfill

Site 8, the Demolition Debris Landfill (formerly identified as SWMU 84 in the RFA) is located at the northeast corner of the intersection of Amphibious Drive and Helicopter Road (**Figure 2-~~11~~10**). Landfilling operations occurred from 1971 to 1979, and approximately 4,840 yd^3 of inert waste was reportedly contained in the landfill. Waste disposal occurred to a depth of 3 feet over an approximately 2-acre area. The landfill was constructed in a pit where the PWC Transportation Division excavated material to surface parking lots. Landfill waste included debris from buildings destroyed by fire, concrete piping, debris removed from the bar screen in the base sewage pump stations, and potentially mercury-contaminated carpeting from the demolition of a dental clinic. No release controls were in place at the site, and no waste inventory is available.

Site 8 is situated adjacent to wetlands fed by a drainage canal from Lake Bradford, runoff from surrounding onsite and offsite areas, tidal inflow from Little Creek Cove, and discharge from the surficial aquifer. Groundwater flow in the Columbia Aquifer at Site 8 appears to be in the northeast direction, following topography, and discharges to Little Creek Cove, adjacent wetlands draining into the cove, and two ponds. Access to the area is unrestricted, although heavy vegetation likely minimizes access by Base personnel.

The Demolition Debris Landfill was included in the Navy's RRRS. Five surface soil, four subsurface soil, and three groundwater samples were collected at Site 8. A high risk ranking was determined for Site 8 because of the presence of SVOCs, pesticides, PCBs, VOCs, and metals in site media.

The landfill was the subject of an SI in 1998. Groundwater, soil, and sediment sampling were conducted. The Final SI report, dated December 1999, also included a qualitative HHRA (CH2M HILL, 1999b).

A site reconnaissance was conducted in December 2000 to quantify the amount of surface demolition debris present at the site. An EE/CA was completed for Site 8 whereby complete removal of surface debris was the selected alternative (CH2M HILL, 2001f). Removal of 675 yd^3 of miscellaneous wooden, concrete, and metal debris took place in January 2002. All materials were stockpiled, separated, and disposed of in appropriate facilities as documented in the Closeout Report (CH2M HILL, 2002b).

To fill data gaps identified in the 1998 SI, RI sampling was conducted in January and February 2002. The RI at the site consisted of a soil cover survey, trenching, and sampling of soil, groundwater, surface water, and sediment. Trenching activities revealed that the bulk of the waste was located in the central to northeastern area of Site 8 and varied in thickness from a few inches to greater than ~~seven~~7 feet. PAHs, pesticides/PCBs, and/or metals were detected in soil, sediment, surface water, and groundwater above screening criteria. The RI/HHRA/ERA was finalized in April 2004 (CH2M HILL, 2004f). The HHRA concluded that there are no unacceptable human health risks based on chemical concentrations in soil, sediment, and surface water. However, direct contact with waste and waste-impacted soil by current and future human receptors may present an unacceptable risk. Additionally, dermal contact with and/or ingestion of groundwater by future receptors may result in unacceptable risks. The ERA concluded that potential site-related ecological risks were present in wetland/aquatic areas, DP 13, Pond 1, and Pond 2. COPCs identified for the tidal wetlands included pesticides and PAHs. PAH concentrations were highest in the vicinity of former DP 13 and represented a potential risk to lower trophic level receptors in the sediment. Selenium was identified as a COPC in Pond 1 sediment, although risks were expected to be very low. COPCs identified in Pond 2 sediment included metals and pesticides. The ERA recommended that additional consideration be given to address the residual debris left in Pond 2 and DP 13 sediments when evaluating remedial action alternatives.

An EE/CA was developed in 2005 and identified complete removal of the demolition debris landfill, removal of debris and surface sediment at DP13 and Pond 2, and the creation of tidal wetlands at the site as the preferred alternative (CH2M HILL, 2005b). Prior to implementation of the removal action, pre-characterization (May 2005) and pre-confirmation (July 2005) sampling was completed to verify the appropriate future use and/or disposal options for material to be removed and identify a depth bgs at which waste was no longer present and soil

contaminant concentrations were below screening criteria (RBCs and background). The NTCRA was completed September 2005 through August 2006 and consisted of the following: removal of approximately 28,000 tons of waste, soil, and sediment from the landfill, DP13, and Pond 2 areas; improvement of the existing wetland through the replacement of 0.19 acres of a *Phragmites*-dominated marsh in the area of DP13 to one dominated by *Spartina*; creation of a 1.56 acre tidal wetland in the area of the former landfill and Pond 2; and the construction of a nature trail and wildlife observation platforms. A CCR was prepared in June 2007 to document removal activities (JV I, 2007b).

An addendum to the June 2007 CCR documents the mitigation of potential human health and ecological risks and groundwater risk management decisions agreed upon by the Navy, USEPA, and VDEQ (CH2M HILL, 2007g). The CCR Addendum also documents the results of additional groundwater data collection efforts that occurred in January, June, and September 2007 in support of groundwater risk management considerations. The Navy, in partnership with USEPA and VDEQ, agreed that in conjunction with the removal of waste, waste-impacted soil, and sediment, the ecological services value associated with the creation/restoration of a tidal wetland compensates and/or mitigates the low potential ecological risks associated with metals, PAHs, and PCBs identified in the ERA. Additionally, based upon results of additional sampling conducted in 2007, the Navy, in partnership with USEPA and VDEQ, agreed that there is no unacceptable human health risk associated with arsenic and vanadium in groundwater. An NFA Proposed Plan for Site 8 was submitted for public review and comment in February 2008 (CH2M HILL, 2008a) and an NFA ROD was finalized in August 2008 (CH2M HILL, 2008b).

SWMU 7—Small Boats Sandblast Yard~~)~~

"New" SWMU 7, the Small Boats Sandblast Yard, is located along piers 36 through 55 at Desert Cove (**Figure 2-11**). This SWMU is also referred to as SWMU 137 in the RFA and was previously identified as part of IR Site 2 during the IAS. The area of SWMU 7 was used to sandblast and paint ships until 1996, when sandblasting activities were moved to an indoor facility. The Small Boats Sandblast Yard was used to store spent ABM while awaiting characterization EP toxicity test results. Approximately 4,000 yd^3 of ABM from sandblasting activities generated between 1960 and 1982 were stored in the yard.

No release controls have been identified for this unit. Based on visual site inspections conducted by Earth Technology Corporation in 1988, releases of spent grit and oily substances to the soil and Desert Cove have occurred in the Small Boats Sandblast Yard. According to the Navy's responses to the RFA, oil-stained soil in the area has been removed. ABM is currently present in the compound near CB125, CB317, and CB318. A small amount of ABM was also found west of Building 3869.

The southwestern portion of SWMU 7 is the site of the new paint blast facility, CB125. Before construction of the building, NAVFAC Atlantic contracted with ATEC Environmental to conduct a soil and groundwater investigation. Five soil locations were sampled. The samples were analyzed for total metals and EP toxicity metals. ATEC noted in their summary report that the only metal detected above the method detection limit in the EP toxicity analysis was zinc at 3.4 parts per million. This amount is below the hazardous waste characteristic. In January 1993, three soil and three groundwater samples were collected from wells installed at the site. Soil samples were analyzed for Toxicity Characteristic Leachate Procedure (TCLP) metals, and groundwater samples were analyzed for total metals. These samples were collected in the immediate area of the new sand blasting facility CB125. The soil results were found to be below the hazardous waste characteristic. Arsenic (maximum = 287 micrograms per liter [µg/L]) and cadmium (maximum = 16 µg/L) were the only metals detected in groundwater. A site reconnaissance was conducted in 1999 for the visual presence of ABM. The presence of ABM was noted in the area of CB125, and trace amounts were observed in the area along small boat piers 51 through 44.

A Final SI report for SWMU 7 was submitted in August 2001 (CH2M HILL, 2001g) with a corresponding Screening Ecological Risk Assessment (SERA) completed in January 2001 (CH2M HILL, 2001a). The SI field activities conducted in May 2000 included the collection and analysis of surface and subsurface soil, sediment, and groundwater samples. Three monitoring wells were installed at SWMU 7, and 28 co-located surface and subsurface samples were collected. Five sediment samples were collected along the boat piers in Desert Cove. Co-located surface and subsurface samples were analyzed for TAL metals and PAHs. Soil samples collected during monitoring well installation were analyzed for TCL organic compounds and TAL metals. All sediment samples were

analyzed for TAL metals, PAHs, grain size, pH, and total organic carbon (TOC). One sediment sample was also analyzed for TCL organic compounds. All groundwater samples were analyzed for TCL organic compounds and TAL metals. Analytical results were qualitatively evaluated through a comparison with USEPA Region III RBCs, VDEQ standards, MCLs, and background levels established for JEB Little Creek.

Groundwater, surface soil, subsurface soil, and sediment samples were collected as part of an RI in August and September 2002. During the investigation, three additional monitoring wells were installed at the site. The RI/HHRA/ERA concluded that there were no overall human health or ecological risks in soil or groundwater at the SWMU (CH2M HILL, 2004p); however, the presence of ABM residues in the northern portion of the site was a potential continuing source of contaminants to sediment in Desert Cove. During development of the RI, a Navy Military Construction (MILCON) project to demolish and replace the existing piers and dredge limited areas of Desert Cove was being planned. Due to the possibility that the project may result in the removal of contaminated sediment that exceed acceptable levels, the RI recommended that further site sediment evaluation be postponed until project completion.

Although there was no overall human health risk in surface soil at SWMU 7, one surface soil result (LW07-SS24) indicated lead at concentrations above the USEPA Region III residential child soil screening value (400 milligrams per kilogram) as determined by the Integrated Exposure Uptake Biokinetic (IEUBK) model. To eliminate the potential human health exposure risk, the lead-impacted area was delineated for removal and recorded in a Technical Memorandum in February 2004 (CH2M HILL, 2004a). The results of the delineation activities were incorporated into the EE/CA for SWMU 7 (and SWMU 8), which was finalized in June 2004 (CH2M HILL, 2004g).

The Interim Removal Action (IRA) for surface soil at SWMU 7 was completed in September of 2004 and successfully eliminated the potential human health exposure risk for terrestrial media at SWMU 7. Subsequently, NAVFAC, USEPA, and VDEQ agreed to separate the terrestrial and aquatic portions of the site to best manage the remediation process. The terrestrial portion of the site was named SWMU 7a and the aquatic portion of the site was named SWMU 7b. A Site Closeout Report was completed for SWMU 7 in December 2004 (CH2M HILL, 2004q). The PRAP for SWMU 7a was finalized in April 2005 (CH2M HILL, 2005e) and an NFA ROD was signed in June 2005 (CH2M HILL, 2005i). Future documentation and remedial activities beyond the Final RI/HHRA/ERA will refer to SWMU 7b as the aquatic portion of the site (sediment and surface water of Desert Cove).

A MILCON project was completed in 2008 that included demolition of existing piers 44-51 and the construction of six new piers along the eastern edge of Desert Cove with a corresponding new quay wall along the eastern and southern edges of the cove. Sediment containing ABM remained in place behind the metal sheet piling of the newly installed quay wall, thereby removing most of the exposure pathway for ecological receptors. A revised ERA work plan was finalized in November 2009 detailing sampling procedures for sediment remaining outboard of the new quay wall. Sediment sampling was conducted in November 2009 to quantify potential ecological risks in sediment following the MILCON action. To further develop the site CSM, benthic invertebrate sampling was conducted in August 2010 per the draft SAP, later finalized in October 2010 (CH2M HILL, 2010g). Results of the post-MILCON evaluation indicated potentially unacceptable ecological risks to the benthic invertebrate community may be present within limited portions of SWMU 7b (northeast corner of the Pier Area) (CH2M HILL, 2012a).

In conjunction with the scheduled maintenance dredge and SWMU 3 NTCRA, the Tier I Partnering Team agreed to conduct an NTCRA to address contaminated sediment at SWMU 7b. An EE/CA was finalized in January 2013 and identified mechanical dredging, offsite solidification, upland disposal, and replacement with clean fill as the preferred removal alternative (CH2M HILL, 2013a). The AM for the NTCRA was signed in January 2013 (CH2M HILL, 2013b). Prior to implementation of the removal action, pre-removal action confirmation sampling was conducted to determine the lateral and vertical extents of removal required to mitigate ecological risks at SWMU 7b (CH2M HILL, 2013c). The NTCRA was completed in May 2013. In September 2013, a Construction Summary Technical Memorandum was finalized to document successful completion of NTCRA activities and mitigation of ecological risks associated with metals in sediment (CH2M HILL, 2013g). An NFA Proposed Plan was completed in September 2013 (CH2M HILL, 2013f) and the NFA ROD was signed in September 2013 (CH2M HILL, 2013h).

SWMU 8—West Annex Sandblast Area

"New" SWMU 8, the West Annex Sandblast Area, is also referred to as SWMU 144 in the RFA, and has also previously been identified as part of IR Site 2 in the IAS. SWMU 8 consists of three discontinuous parcels of land near the northwest corner of the base (**Figure 2-12**). An area at the northeast corner of the intersection of Guadalcanal Road and Amphibious Drive was previously used for sandblasting activities to remove paint from boats. As boats were sandblasted in the area, sandblast residue accumulated on the ground. Between 1949 and 1954, spent sandblasting residue was removed from the area and stored in separate areas north of Midway Road, south of Guadalcanal Road, and east of Amphibious Drive. An estimated 5,125 yd^3 of residue was generated and stored in these areas between 1949 and 1954, and an additional 3,525 yd^3 were generated between 1954 and 1971. A reconnaissance of the area in 1999 noted ABM in the area surrounding Water Tower 1553 from the surface to a depth of 5 inches.

A Final SWMU 8 SI Report was submitted in August 2001 (CH2M HILL, 2001g), with a corresponding SERA in January 2001 (CH2M HILL, 2001a). The SI field activities were conducted in May 2000 and included the collection and analysis of the surface and subsurface soil, sediment, and groundwater samples. Four monitoring wells were installed at SWMU 8, and 38 co-located surface and subsurface samples were collected. Six sediment samples were collected at SWMU 8. Co-located surface and subsurface samples were analyzed for TAL metals and PAHs. Soil samples collected during the installation of the monitoring wells were analyzed for TCL organic compounds and TAL metals. All sediment samples were analyzed for TAL metals, PAHs, grain size, pH, and TOC. One sediment sample was also analyzed for TCL organics. All groundwater samples were analyzed for TCL organic compounds and TAL metals. Analytical results were qualitatively evaluated through a comparison with USEPA Region III RBCs, VDEQ standards, MCLs, and to background levels established for NAB Little Creek. Groundwater in the Columbia Aquifer generally flows toward the small boat piers (Piers 11 through 19) and Little Creek Channel. An EE/CA was also prepared for SWMU 8 during FY 2000. The EE/CA presented the findings of the soil boring survey conducted to delineate the horizontal extent of ABM present in the surface and shallow subsurface soils at the site. Three recommendations for removing the ABM were presented in the EE/CA. The third alternative, excavation of contaminated material to residential land use criteria, was the preferred alternative of the three. Based on calculations in the EE/CA, this called for the excavation of approximately 2,200 yd^3 (3,600 tons at 120 pounds/yd^3) of soil in the vicinity of Water Tower 1553.

In November 2000, an ~~interim removal action~~IRA was initiated at SWMU 8 to remove the surface and subsurface soil contaminated with ABM. The removal action consisted of excavating between 2 and 10 inches of soil in the vicinity of the water tower for offsite disposal at a Navy-approved disposal facility. Confirmation samples were taken on the floor of the excavation during the removal action to ensure screening criteria were being met. *In situ* samples were field-screened for lead using an X-ray fluorescence (XRF) scanner. Fifteen confirmation samples were also obtained over the approximately 3-acre area and analyzed for TAL metals and PAHs. Three additional samples were collected for full suite analysis including TCL organics. Upon completion of the removal action, approximately 4,600 tons of soil were excavated and removed from the site (OHM, 2001).

An RI was conducted for SWMUs 3, 7, and 8 in August and September 2002. During the investigation, six additional monitoring wells were installed at SWMU 8. Groundwater, surface soil, subsurface soil, and sediment samples were collected for analysis. A Draft RI/HHRA/ERA Report was submitted for regulatory review in November 2003. Conclusions indicated that there were no overall human health or ecological risks for soil, groundwater, and surface water. The highest ecological site-related potential risks were associated with metals in outfall sediments. NFA was recommended for soil, groundwater, and surface water, and further sediment and confirmatory soil samples were recommended to delineate the contaminated area for removal.

Additional subsurface soil and sediment sampling was conducted in January 2004 to delineate elevated PAH concentrations detected in the soil near Water Tower 1553 during the SI conducted in May 2000 (LW08-DP23), and metals in sediment detected during the recent RI activities conducted in August 2002 (CH2M HILL, 2004b). Based on the results of the additional soil samples collected in the vicinity of Water Tower 1553, the Tier I Partnering Team agreed not to pursue an ~~interim removal action~~IRA to address the subsurface soil PAH contamination at SWMU 8 based on the absence of human health risk. In addition, the PAH contamination was

not likely a result of CERCLA site activities, because the water tower is still operational. The additional subsurface soil results from samples collected in January 2004 were incorporated into the HHRA as part of the Final RI/HHRA/ERA (CH2M HILL, 2004r). The results from the sediment delineation activities were used in development of an EE/CA to remove sediment south of Outfalls 16 and 17 at the SWMU (CH2M HILL, 2004g). The sediment south of Outfalls 16 and 17 were removed as part of an IRA conducted in September 2004. An SCR was completed for SWMU 8 in December 2004 (CH2M HILL, 2004s). Because there was no overall human health or ecological risk in groundwater, an NFA Proposed Plan was submitted for SWMU 8 in March 2005 (CH2M HILL, 2005f), and an NFA ROD was signed in June 2005 (CH2M HILL, 2005j).

2.5 Military Munitions Response Program

The DoD has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program to address munitions and explosives of concern (MEC) and munitions constituents (MCs) at other-than-operational ranges. The DoD and the Navy are establishing policy and guidance for munitions and response actions under the MMRP; however, the key program drivers developed to date conclude that munitions response action will be conducted under the process outlined in the National Contingency Plan ~~(NCP)~~ as authorized by CERCLA.

Six other-than-operational ranges, the Anti-Aircraft (A-A) Target Rifle Range, Chemical Defense Area, Depth Charge Testing Area, 1942 Pistol Range, 1944 Pistol Range, 1953 Pistol Range, and the Morale, Welfare, and Recreation (MWR) Skeet Range were identified and associated with JEB Little Creek. Following identification, a Preliminary Assessment (PA) was completed for the MWR Skeet Range and recommended further investigations (Malcolm Pirnie, 2006). In addition, a five-site PA was finalized in September 2007 for the remaining areas identified as potentially impacted by MMRP activities (Malcolm Pirnie, 2007) and recommended further investigation for the A-A Target Rifle Range, Depth Charge Testing Area, 1944 Pistol Range, and 1953 Pistol Range (**Figure 2-1**). Based upon the results of the PA, a consensus agreement to formally remove the Chemical Defense Area and 1942 Pistol Range from further study was signed by the Navy, USEPA, and VDEQ in September 2011.

2.5.1 Response Complete Sites – Site Screening Process

Skeet Range

The former MWR Skeet ~~range~~Range comprises approximately 31 acres in the northwestern portion of the installation, adjacent to Desert Cove and Little Creek Channel (**Figure 2-13**). According to installation personnel, the range was used solely for recreational skeet shooting from 1962 to 1985. During range operation, three buildings were present on site: the high house, the low house, and storage Building 3092. A 900-foot surface-danger zone extended north of the range, overlapping a portion of Desert Cove and Little Creek Channel. Following range closure in 1985, the buildings were demolished, and approximately 75 percent of the range area was graded for construction of a concrete landing pad for landing craft air cushions (LCACs). A steep, man-made, earthen berm and concrete wall were constructed around the LCAC pad and cover a majority of the former firing area.

A PA was conducted to assess the potential for MEC and MC from a site release (Malcolm Pirnie, 2006). The PA concluded there is no potential for MEC at the former range; however, potential MC may include lead, antimony, copper, zinc, and arsenic from bullets and fragments, and PAHs resulting from clay targets. NA was recommended for MEC at the site. Soil and sediment sampling from the areas outside the LCAC pad and along the shoreline surrounding the site was recommended to further investigate the potential for MC (metals and PAHs) at the Skeet Range.

Surface/subsurface soil and groundwater sampling was conducted in June 2010. A site-screening process (SSP) report was finalized in February 2011 and documented the results of the investigation and screening HHRA (CH2M-HILL, 2011b). The SSP report concluded the MWR Skeet Range does not pose a threat, or potential threat to public health, welfare, or the environment. A consensus agreement to remove the site from further study was signed by the Navy, USEPA, and VDEQ in January 2011.

Anti-Aircraft Target Rifle Range/1944 Pistol Range

The former A-A Target Rifle Range and 1944 Pistol Range are located in the western portion of the installation, adjacent to Little Creek Channel and Little Creek (**Figure 2-14**). The A-A Target Rifle Range comprises approximately 0.11 acres, and the 1944 Pistol Range approximately 0.04 acres. The A-A Target Rifle Range was used primarily for air-rifle training from approximately 1943 to 1944, and the 1944 Pistol Range was used in 1944; however, both ranges may have been used as late as 1948. It is unknown whether firing at the ranges was directed into berms or north towards Little Creek; however, based upon the orientation of the ranges and proximity of roads and other ranges, the direction of fire is presumed to be north. During A-A Target Rifle Range operations, one building, the Hose Reel House, was present on the site; however, building activities were likely associated with firefighting and not range operations. Between 1951 and 1954, the area surrounding the ranges was significantly redeveloped. Aerial photographs indicate Little Creek was dredged, and the southern shoreline was expanded for a series of boat piers. Currently, the majority of the former A-A Target Rifle Range is paved, with a small grassy area located in southwestern corner and the former 1944 Pistol Range is mostly grass covered. A small storage building overlaps the northwestern corner of the A-A Target Rifle Range and southeastern corner of the 1944 Pistol Range.

A PA was conducted to assess the potential for MEC and MC from site releases (Malcolm Pirnie, 2007). The PA concluded there was no potential for MEC at the former A-A Target Rifle Range and 1944 Pistol Range; however, potential MC may include copper, lead, and steel from use of lead pellets in air rifles at the Target Range and antimony, arsenic, copper, lead, nickel, and zinc from small arms and black/smokeless powder used at the Pistol Range. NA was recommended for MEC at both sites. Although Little Creek has been dredged following range activities and Little Creek Channel continues to be periodically dredged, surface water and sediment sampling in Little Creek and Little Creek Channel was recommended to further investigate the potential for MC (metals and black/smokeless powder) at the A-A Target Rifle Range and 1944 Pistol Range.

Following the PA, a records search was completed and a detailed CSM was developed to portray the historical activities, land developments over time, and limited current/future receptor exposure pathways. Based on the results of the desktop evaluation, the SSA visits, the Navy's guidance, and professional judgment, the Tier I Partnering Team agreed that the A-A Target Rifle Range and 1944 Pistol Range does not pose a threat, or potential threat to public health, welfare, or the environment and, therefore, that the areas should be removed from further study. A consensus agreement to remove the sites from further study was signed by the Navy, USEPA, and VDEQ in September 2010 and the SSP Closeout Report was finalized (CH2M HILL, ~~2010d~~2010e).

1953 Pistol Range~~—~~

The former 1953 Pistol Range comprises approximately 0.6 acres in the northern portion of the installation (**Figure 2-15**). The 1953 Pistol Range is located west of Site 9 and south of Beach Drive within the northern portion of the Site 10, Sewage Treatment Plant Landfill, LUC boundary. Historical maps show hills located on the northern and eastern sides of the site. Additionally, a small hill, approximately 1 meter high, was observed in the middle portion of the former range. It is suspected the firing direction was north and the hill located north of the site was used as a natural impact berm. The 1953 Pistol Range was used in 1953; however, the period of operation is unknown. Currently, the former pistol range is undeveloped and covered in natural vegetation.

A PA was conducted to assess the potential for MEC and MC from a site release (Malcolm Pirnie, 2007). The PA concluded there was no potential for MEC at the former range; however, potential MC may include antimony, arsenic, copper, lead, nickel, and zinc from small arms and constituents associated with black/smokeless powder (lead styphnate and lead azide) used at the 1953 Pistol Range. NA was recommended for MEC at the Site. Soil sampling was recommended to further investigate the potential for MC (metals and black/smokeless powder) at the 1953 Pistol Range.

Following the PA, a records search was completed and a detailed CSM was developed to portray the historical activities, land developments over time, and limited current/future receptor exposure pathways. Based on the results of the desktop evaluation, the SSA visits, the Navy's guidance, the presence of a soil cover, the Site 10 LTM groundwater results, the establishment of LUCs at Site 10, the overlap with an active training range, and professional judgment, the Tier I Partnering Team agreed that the 1953 Pistol Range SSA does not pose a threat or

potential threat to public health, welfare, or the environment, and should be removed from further study. A consensus agreement to remove the site from further study was signed by the Navy, USEPA, and VDEQ in September 2010 and the SSP Closeout Report was finalized (CH2M HILL, ~~2010d~~2010e).

Depth Charge Testing Area

The former Depth Charge Testing Area comprises approximately 1,800 acres located in the Chesapeake Bay, offshore of Cape Charles, Virginia (**Figure 2-16**). The site location was estimated using the latitude and longitude readings provided in 1943 memoranda (February and May) documenting the deployment of the depth charges and a review of nautical charts indicating a channel in the Chesapeake Bay with water depths similar to those noted in the memorandum. The site is approximately 25 miles northeast of the installation. The testing area was used for the testing of Mark 10 depth charges in 1943; however, the period of use is unknown. The 1943 memoranda indicate 20 depth charges were dropped, including two that did not detonate. The estimated depth settings of the two un-detonated charges were 23 and 30 meters, and the depth of water in the testing area is approximately 37 meters.

A PA was conducted to assess the potential for MEC and MC from site releases (Malcolm Pirnie, 2007). The PA concluded the former depth-charge area is a suspected MEC area and potential MC may include Torpex and High Blast Explosive. Surface water and sediment sampling was recommended to further investigate the potential for MC (Torpex and High Blast Explosive) at the Depth Charge Testing Area. Additionally, further investigation to locate potential MEC was also recommended.

Following the PA, a thorough records search was completed and a detailed CSM was developed. Based on the Navy's guidance, the uncertainty associated with the location of the depth charges, the possibility of the items functioning after the tests were completed, the low probability of their current functionality, the low risk of exposure with potential receptors, the results of the desktop evaluation, and professional judgment, the Tier-I Partnering Team determined the Depth Charge Testing Area does not pose a threat or potential threat to public health, welfare, or the environment, and should be removed from further study. A consensus agreement to remove the site from further study was signed by the Navy, USEPA, and VDEQ in September 2010 and the SSP Closeout Report was finalized (CH2M HILL, ~~2010e~~2010f).

SECTION 3

3Navy Land Use Planning

The JEB Little Creek ER Program has developed a geographic information system (GIS) that identifies all areas of past or present environmental concern. **Attachment A** identifies the ER sites and identifies the boundaries of potential environmental impact areas, including the extent of groundwater and soil contamination. Sites with LUCs in place are identified on **Table 3-1**. A CD is provided with the GIS layers in ~~Arcview®~~ArcView as displayed on **Attachment A**. This information is available to Base Planning personnel for environmental considerations during Base operational planning and decision making. This GIS information will also be used by Base Planning personnel to ensure that LUCs are maintained at ER sites where the ROD identifies LUCs as part of the remedy.

If in the event DoD activities will influence the areas outlined or highlighted in **Attachment A**, the Navy Regional Project Manager should be consulted. Contact information is listed below:

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SECTION 4

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Attachment A
Land Use Planning Potentially Impacted Areas